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NATIONAL FIRE PROTECTION ASSOCIATION

Quarterly

Published Quarterly at Boston, Mass., by the
NATIONAL FIRE PROTECTION ASSOCIATION
International

from the CARDOX case record...

Out of actual on-the-job fire experience comes evidence that Cardox Fire Extinguishing Systems provide a scope of carbon dioxide performance . . . and standard of effectiveness . . . far beyond the generally recognized advantages of this fast acting, non-damaging, economical extinguishing medium.

File No. S-65, covering an investigator's report on Cardox extinguishment of an oil reclamation plant fire, offers an interesting example of Cardox protection by total flooding . . . one of the many types of protection made most effective by Cardox methods of controlling and applying carbon dioxide:

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60 Batterymarch Street,
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of the

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Vol. 40 July, 1946 No. 1

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Press Association.

A dramatic photo of the chemical plant fire in Philadelphia on April 20 shows fire fighters surrounding the fire in an effort to protect exposed properties. The fire started in the benzol manufacturing building from an unknown cause. See *Recent Fires*.

The Quarterly

Vol. 40 July, 1946 No. 1

Hotel Fires. The tragic hotel fires in Chicago and Dubuque, Ia., described in detail on the following pages, have shocked the country and have resulted in renewed efforts to improve hotel fire safety. At the moment public opinion is active and numerous steps are being taken in various parts of the country to improve hotel fire safety. One practical step has been taken by several city hotel associations, who have employed full time fire protection personnel to provide their members with common sense technical assistance in life-safety problems. How fundamental and how permanent such steps may be is a matter that only time can tell.

The two fires actually present few new lessons. One lesson emphasized is the hazard to life through the use of highly combustible interior-finish materials used in the cocktail lounges of both hotels. Another lesson surely lies in the disclosure of the cumbersome alarm practices which made prompt notification of fire departments in the event of fire doubtful, if not impossible.

These fires are only the latest in a long series of fires that have occurred over the years. The N.F.P.A. publication "Hotel and Apartment Fires," dated January, 1941, contains a record of over 1000 previous hotel fires, many of them involving loss of life. This publication contains a statement of fire-safety principles that is equally valid today. It covers building construction, automatic protection, protection of vertical openings, adequate exits, fire alarm facilities, training of employees, safeguarding of hazards, etc.

It is one thing to make a general statement of the precautions that should be followed in making hotels safe from fire, but it is quite another matter to secure action, particularly in the older buildings which when erected were in accordance with all then existing legal requirements, and which can be adequately protected only at a considerable expense. Results can be obtained but only by a concerted attack on the problem by all concerned. The factors responsible for hotel fires are well known and the needed fire-safety measures are clearly stated in the Building Exits Code and other N.F.P.A. standards, as well as in many modern building codes.

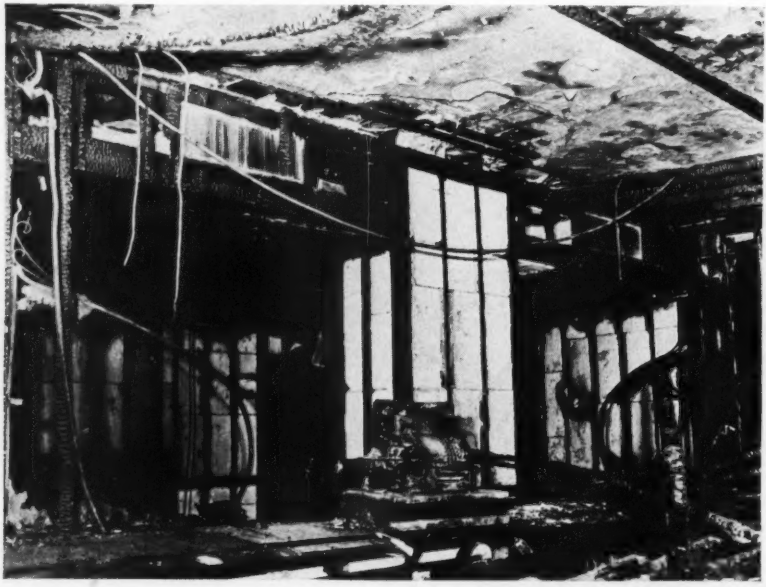
Hotel managers are generally anxious to provide, within reason, the maximum of fire safety for their guests. However, the hotel manager is not a fire protection engineer. Who can blame him if no architect, engineer, insurance man or fire department inspector has ever warned of the danger of open stairs or highly combustible interior finish, if no sprinkler or fire alarm salesman has ever suggested automatic protection, if neither fire insurance nor liability insurance provides an adequate economic incentive for improved life-safety, and if hotel guests exhibit no concern for their own safety?

The LaSalle Hotel Fire.

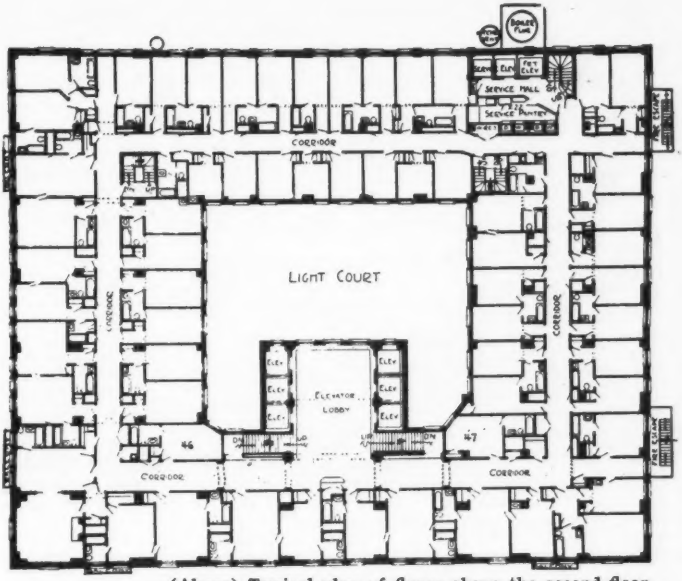
By James K. McElroy,
N.F.P.A. Engineer.

During the night of June 5, 1946, sixty-one of the more than 1000 guests and employees of the LaSalle Hotel in Chicago lost their lives as a result of fire which originated above a suspended combustible ceiling in the Silver Cocktail Lounge, directly off the first floor lobby of the hotel. Those who lost their lives in this hotel tragedy have joined the victims of past holocausts—the Triangle Shirt Waist fire, the Cocoanut Grove fire, the Hartford circus fire and others—who died that fire prevention and fire protection measures necessary to the safeguarding of the public be inescapably drawn to the attention of architects and interior decorators, building officials, fire engineers, hotel managements and the traveling public. Obviously, the LaSalle Hotel fire provides lessons in inherent structural hazards, as well as equally important lessons in the behavior of people faced with an emergency of overwhelmingly tragic possibilities. In this instance, all concerned believed that they were secure in a "fireproof" hotel.

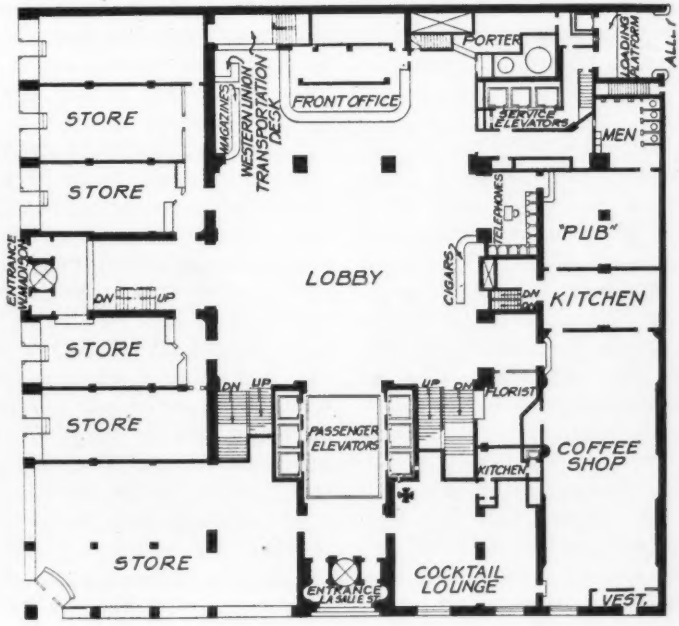
The high degree of combustibility of the interior construction of the cocktail lounge, the adjoining coffee shop, lobby and mezzanine, together with unprotected

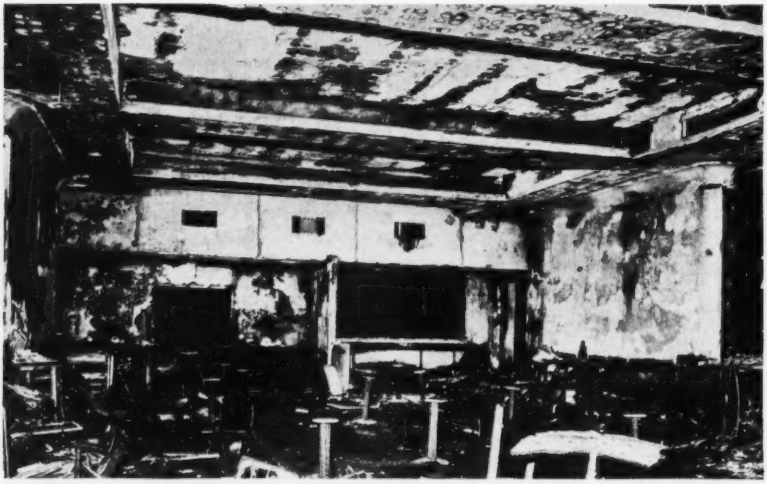


All that remained of the Silver Cocktail Lounge where the fire at the LaSalle Hotel originated. Fire swept into the coffee shop through the unprotected door opening (to left of the cash register) in the center of the photograph. Charred 2 x 4 studs and suspended ceiling members can be clearly seen. Interior finish, highly combustible.



(Above) Typical plan of floors above the second floor. (Below) Plan of first floor. LaSalle St. (East) is at the bottom; W. Madison (South) is at the left.





The gutted interior of the LaSalle coffee shop, adjoining the cocktail lounge. Highly combustible interior finish of this room was glued to the walls and ceiling, all of which was consumed prior to extinguishment.

openings into the elevator shaft at the first floor, and the open stairways (of non-combustible construction) which extended from the basement through the nineteenth floor, were of enormous importance in the development of the fire and the resultant loss of life.

Building Construction.

Throughout the thirty-seven years since the hotel was designed and built and in the absence of serious fire in a vulnerable location in the building, the LaSalle was erroneously thought to be of "fireproof" construction. Other than the highly combustible interior finish which had such disastrous effect when a serious fire did occur, the structure can be considered fire-resistive. It is twenty-two stories in height with basement and sub-basement, of protected steel-frame and reinforced concrete construction. Exterior walls are brick panel type, with interior partitions of 3-in. hollow tile plastered on both sides. Above the second floor level there is an interior court with a continuous corridor around it, with rooms opening off the corridors on both sides. Wood panel doors and transoms were provided for all rooms. Except for steel sash and wired-glass windows in the exterior wall exposing another building across an alley, the sash throughout were of wood construction.

The interior means of egress from the structure, in addition to the unprotected stairways adjacent to the two banks of passenger elevators, were three enclosed non-combustible stairways which did not open directly to the outside at the ground floor level. At the time of the fire a door leading to the enclosed stairway near the service elevators at the mezzanine floor had been left open, and this stair, which offered the nearest egress to the outside of the building at the first floor, could not be used. Two exterior fire escapes were provided at the ends of the north and south corridors on each floor. Each discharged into the alley by means of a counterbalanced section at the first floor level.

Chicago Tribune.

An interior view of the burned out lobby of the LaSalle Hotel. Fire swept into the lobby through the unprotected doorway to the coffee shop in the right background.

Thus was the scene set for the tragedy. No one, least of all those who had known the LaSalle Hotel throughout its long history of public service, realized the inherent danger that existed in the beautiful walnut veneer paneling of the large lobby and mezzanine floor, the combustibility of the interior finish of the cocktail room and coffee shop, or the consequences of unprotected concealed spaces.

The cocktail lounge, where the fire originated, was of more recent vintage than the quietly ornate, paneled lobby and mezzanine. It was a room within a room, constructed of wood studs with gypsum block filler, covered with an attractive but highly combustible interior finish. A circular wood bar was in the center of the room; there were tables and a continuous upholstered wall seat around the walls. The interior finish of the adjoining and communicating coffee shop was also highly combustible, though of different fibrous material, and both rooms opened directly into the paneled lobby.

Whether or not the paneling in the lobby and mezzanine was fire-stopped had long been forgotten, and firemen overhauling after the fire discovered it was not. Who would have coldly calculated prior to the fire that the artistic brain that conceived and designed the warmth and beauty of the paneling had, in effect, put a barn of approximately 60 ft. x 120 ft. in size within a 22-story, fire-resistive structure? What fire or building inspector would have been so inordinately curious that he would ride the top of a passenger elevator cab and discover that additional exhaust ventilation for the cocktail lounge had been improvised by cutting an otherwise concealed hole approximately 3 feet in diameter in the masonry elevator shaft, or that there was a small opening in the tile wall of the same shaft at the first floor level which opened directly into the concealed wall space behind the wall seat of the cocktail lounge? These two openings into the elevator shaft, as well as the lack of masonry above the elevator door lintels

Chicago Tribune.

The LaSalle Street entrance and the north bank of passenger elevators. Concealed openings in this shaft permitted a strong draft on the burning interior of the cocktail lounge. Note the unprotected door opening into the paneled lobby from the cocktail lounge (to left of hotel entrance in photo) and the burned out panels of the faked elevator door (opening next left) and above the lintels of the two operating elevators shown in this photograph.

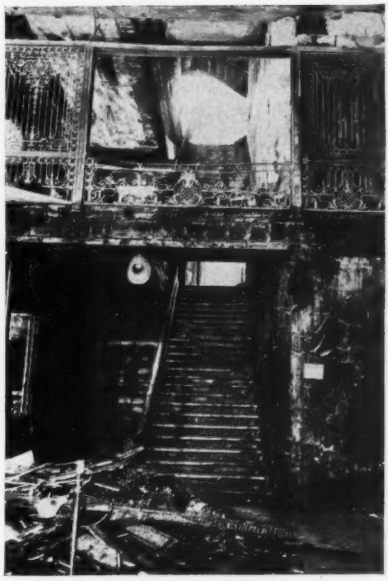
behind the wood paneling at the first floor lobby openings to both banks of passenger elevators, eventually contributed to the passage of heat and smoke throughout the upper floors of the building.

Cause.

The exact cause of the fire in the cocktail lounge is unknown. Two alternative possibilities existed. One, that an unventilated metal and glass indirect lighting fixture overheated and ignited wood above the suspended combustible ceiling. The second, that a carelessly handled cigarette in the elevator shaft may have passed through the small opening into the concealed space behind the wall seat in the cocktail lounge. Either theory is credible.

Discovery and Alarm.

There is conflicting testimony regarding the discovery of the fire and the resultant alarm. A customer in the Silver Cocktail Lounge reported that he saw a small wisp of smoke, at first thought to be steam, at approximately 12:20 A.M. Smoke was seen to come from behind a seat cushion of a wall seat adjacent to the small opening in the elevator shaft wall, and when the seat was removed fire was visible. The customer who first noticed the fire reported that he walked into the street and proceeded to the nearest corner, where there was a blind newsboy who delivered papers at the hotel news stand. The customer told the blind boy not to go into the hotel as there was a fire in the lounge, and asked for directions to the nearest street alarm box! The boy was unfamiliar with a box location, and the customer gave up his idea of pulling a street box. Familiar with the hotel building, but not with the hotel management's instructions in the event of fire emergency, the customer believed that an immediate alarm would be given by hotel personnel, and stood across the street quietly awaiting the arrival of the fire department. A few minutes later he saw flames shooting into the street from the window opening on to LaSalle Street from the cocktail lounge. Fire apparatus had not yet arrived. Other reports place the time of discovery at various times up to 12:30 A.M.



The open stairs to the mezzanine and second floor from the lobby was the breeching through which flames and hot gases were transmitted to the upper floors via the open stairways adjoining the passenger elevators to the nineteenth floor.

The first fire engine company arrived promptly from its station a short distance away, following the receipt of a telephoned alarm from the hotel at 12:35 A.M. The fire department verified the statement of the bar's customer that fire was coming out of the window of the cocktail lounge as they rolled to a stop. A second alarm was given at 12:37 A.M. The fifth alarm followed at 12:42 A.M. In all, thirty-four engine companies, five ladder companies, three squad companies, two water towers, two high pressure tenders and one ambulance responded to the fifth alarm. Special calls brought out five more ladder companies, seven more squad companies and fifty-two police patrol wagons for use as ambulances.

What transpired in the period between the discovery of fire and the telephoned alarm is not yet clear. Hotel officials, however, testified at the inquest that hotel rules provided that employees of the hotel were not permitted to call the fire department without first reporting to their superiors, who in turn reported fire to either the manager, the house detective, the chief engineer or the chief electrician. These men were authorized to call the telephone operator, who then transmitted the alarm to the fire department IF she recognized the voice of the caller as that of a responsible department head. It is reported that in this instance the hotel detective authorized the telephone operator to call the fire department.

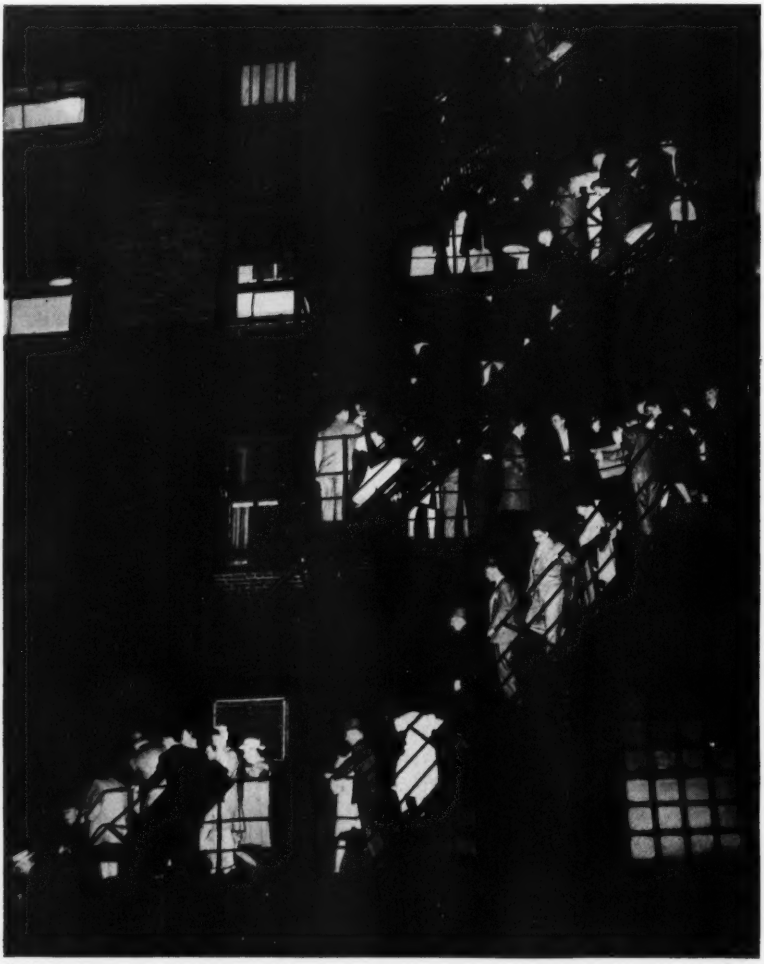
The exact time that the heroic telephone operator started to warn occupants of the upper floors of the hotel may not be determined. Later this woman, trapped behind the barred windows of her second floor switchboard room in the rear of the build-

Chicago Tribune.

Another stairway to the mezzanine floor, Madison Street side of the lobby. Paneling burned from the hollow tile walls, with heat sufficient to crack the marble treads on the stairs.

ing, lost her life by asphyxiation. Hundreds, including a blind woman and her "seeing eye" dog, walked down the fire escapes on the alley side of the building. Many escaped due to prompt and effective ladder work by firemen working to outside windows of the building. Many were saved by firemen, policemen and others who assisted in the search of smoke-filled corridors and rooms.

The length of time that the fire if it originated in the concealed ceiling space over the cocktail lounge, smouldered and worked its way down the concealed space



Acme.

Open stairways and corridors rapidly filling with smoke and heat forced LaSalle guests to use exterior fire escapes. Three interior enclosed stairways did not discharge to the open at the ground floor, leaving the fire escapes as the only certain means of egress and the only means for the period in which the corridors offered safe passage.

between the lobby paneling or behind the back of the wall seat near the elevator shaft will never be known, but it was certainly aided by the draft through the small opening into the 22-story masonry-walled elevator shaft.

The Fire Spreads.

From appearances following the extinguishment of the fire, the course of fire spread was extremely rapid as soon as the highly combustible interior finish of the cocktail lounge was totally involved, and was aided and abetted by the improvised 3-ft. ventilation opening into the adjacent elevator shaft. The ease with which fire could spread out of the cocktail lounge into the lobby and coffee shop is not surprising and was due to the combustibility of the interior finish of these areas and the presence of unprotected openings from both the cocktail lounge and the coffee shop into the lobby. Heat from the fire raging in the cocktail lounge and the coffee shop undoubtedly caused the dried-out highly varnished walnut veneer on the paneling to delaminate. Thus, ignition of the delaminating veneer occurred at a much lower temperature than had ordinary wood been involved. Laboratory tests on representative samples of the panels since the fire indicate the surface spread of fire on the face of the panels was approximately five times faster than surface spread on ordinary red oak.

The lack of masonry above the lobby floor elevator doors behind the wood paneling is believed to have become vital at this point, as 22-story flues in the two banks of passenger elevators were now available to the fire. Unquestionably, the open stairways adjacent to these elevators, which extended upwards to the nineteenth floor, also provided a strong draft. Later it was discovered by firemen that heat from the first floor fire sweeping up the non-combustible open stairways ignited combustible interior trim on the LaSalle

Chicago Daily News.

Hundreds of feet of aerial and other ladders were used to rescue occupants from the exterior rooms of second to sixth floors of the LaSalle Hotel which were the most seriously endangered.

Street side of the building on the second, third, fourth and fifth floors,

Extinguishment.

Such was the task confronting the first engine company to arrive on the scene. Firemen drove their way into the inferno from the LaSalle Street entrance, using four hose lines; two 2½-in. lines with 1¼-in. tips equipped with shut-off nozzles, and two 3-in. lines with 1¼-in. open tips. As more engine companies arrived and water could be put on the fire, it was brought under control in about a half hour by fighting into the lobby from the Madison street side as well. One engine company fought its way up the open stair to the mezzanine behind the passenger elevator and thence to the seat of the fire in the corridors of the second, third, fourth and fifth floors. It was a tough job and well done.

Observations Following the Fire.

Standing in the center of the burned-out lobby after the fire with a clear view to the top of the open stairway at the second floor the raw tile partition of the second floor corridor, from which plaster had spalled, was clearly visible. The wonder is that any one on the lower floors of the building on the LaSalle Street side escaped with his life. Two women cashiers were found dead behind their cage on the first floor; no lives were lost in the basements. A mass of debris, the result of overhauling, lay at one side of the room. Removal of the remaining paneling from the columns, walls and ceilings laid bare the undamaged concrete and tile-protected columns and beams, monuments to the trust placed in them years ago and so recently put to the test.

It was immediately noticeable that the passenger elevator shafts had served as flues. Inspection of the elevator machinery

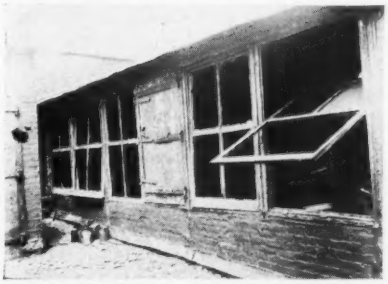
Chicago Tribune.

The delamination of the varnished walnut veneer panels in the lobby of the LaSalle Hotel, which were found on tests after the fire to burn five times as rapidly on the surface as ordinary red oak lumber.

platform above the twenty-second floor disclosed scorched and burned wood timbers. Paint on metal ventilation equipment six feet from an open window at the top of the shaft was also scorched. In the same general location, ten feet from the elevator platform window, a Fahrenheit thermometer calibrated to 120° F. had burst.

There was little indication of damage on the twentieth and twenty-first floors except for paint blisters on the metal elevator door frames and doors which, throughout the length of both shafts, did the work expected of them.

The wood window frame on the outside court wall of the north passenger elevator shaft was burned out at the nineteenth



Wood timbers in the north passenger elevator machinery platform above the twenty-second floor charred from the heat in the shaft. Paint peeled on the outside of the metal door entrance to the platform.

floor. Observation from the roof disclosed that all frames in this shaft were burned to the court roof sixteen floors below.

Condensation marks near the ceiling on the walls of the corridors of the eighteenth floor were the first indication of the presence and amount of smoke and hot gases which filled the building.

With minor variations, the floor layout of rooms and corridors is typical from the third to the seventeenth floors. (See typical floor plan.) At the seventeenth floor, the condensation mark on the corridor walls was approximately five feet above the corridor floor. It was thus evident that the red exit lights near the ceiling in the corridors at the fire escape exits would not have been visible to occupants of rooms who were not familiar with their locations prior to smoke filling the corridors. Whether significant or not, all electric clocks in the corridors had stopped at 12:42 A.M.

The first indication of the important part in the tragedy played by the wood transoms and doors to the rooms in the building was visible on the seventeenth floor. Rooms with open transoms were found to be damaged by smoke on the inside. Those which had closed transoms were unmarked by fire or smoke. Walking through the seventeenth floor corridor with its clearly visible evidence of heat and smoke, it was impossible not to consider the number of lives that might have been saved had only the corridors of the upper floors been protected by automatic sprinklers.

From the seventeenth floor to the twelfth floor there was very little difference in the appearance of the rooms and corridors.

On the eleventh floor, smoke and heat discoloration in the corridors extended to the floor level and was more pronounced in appearance in the corridors off the open stairways on the LaSalle Street side of the building. This condition became worse from the eleventh to the sixth floors, with the soot and condensation more heavily encrusted on the walls.

The interior court adjacent to the south passenger elevator shaft. Note burned out windows (at the head of the open stairways) on the second, third and fourth floors. A woman lived through the fire in a fifth floor room just above the burned out window in the background.

While the safety of occupants in the corridors above the sixth floor was doubtful, there is little doubt that occupants of rooms from the sixth to the second floors, *particularly those on the inside court rooms,* were faced with a horrible choice. Almost certain rescue was possible for those on the outside of the building.

Fire and heat had belched into the interior court from the court windows on the third, fourth and fifth floors, and the typical rooms Nos. 46 and 47 on these floors were effectively cut off. An unconscious woman was found by firemen after the fire was extinguished on the floor of the bathroom of No. 546, and she lived. Rooms adjoining with open transoms on the fifth and sixth floors were severely damaged, while those with closed transoms were undamaged. A battalion chief lost his life from the effects of heat and smoke after he was found on the sixth floor smoke-filled corridor floor and removed via the fire escape.

Spalled plaster was evident in the area of the open stairways on the fourth floor. It was amazing to find wood panel doors which had held against the fire in the corridors. Some doors had even burned off their hinges, without soot or smoke marks on the interior of the rooms. Doors to rooms Nos. 400 and 401 in the extreme southwest corner were scorched on the corridor side.

Marble treads on the open stairways from the fourth to the third floors were cracked from the heat and there was a 2-in. bow in the marble baseboard in the corridor on the third floor. Wood doors and transoms which had burned through without soot or smoke damage in the rooms indicated the strong pull which the open stairways exerted on the fire burning on the first floor fed by the walnut veneer paneling, the highly combustible interior finish of the cocktail lounge and the coffee shop.

The cast iron risers of the open stairway failed from the heat on the flight of steps from the third to the second floors. It is fair to state that the most severe damage above the first floor was found on the second floor near the elevator lobby and at the head of the open stairways from the lobby to the second floor. Glass in windows and lighting fixtures fused on the second, third, fourth and fifth floors. Rooms on the second floor were largely used for office space, and fortunately were vacant at the time the fire occurred. Oddly, the rear corridor of the second floor was only damaged by soot and smoke, yet it was in this area that the telephone operator lost her life due to the barred windows on her switchboard room. An effort was made to save her, but she collapsed during the attempt.

Loss of Life.

Many lost their lives by asphyxiation; many were found without a mark on their bodies, lying prone in corridors, rooms and bathrooms. There is no accurate account of the locations in which loss of life occurred, though bodies were found on several floors above the first floor and mezzanine. The body of a male employee of the hotel was found on the twenty-second floor, but he is believed to have died from overexertion in climbing the enclosed stairway. Several died from burns. Seven bodies were found on the roof of the inner court over the lobby at the second floor. In view of the undamaged condition of many rooms which had both the doors and transoms closed, it is reasonable to believe that many of those in *outside rooms* who lost their lives could have saved themselves had they calmly closed the doors and transoms and opened windows.

International News.

Charred and spalled remains of the third floor corridor along the LaSalle Street side of the LaSalle Hotel. In the upper right-hand corner of the photograph, plaster undamaged by smoke or heat can be seen on the inside of a room near the elevator lobby, though the door of the room is severely damaged by fire.

Those in rooms with windows opening into the interior court who could clearly see fire breaking from the windows of the passenger elevator shaft up to the nineteenth floor and the third and fourth floor windows adjoining the open stairways and the passenger elevator banks were no doubt justified in their frantic belief that the fire which was gutting the paneled lobby and mezzanine, the cocktail lounge and the coffee shop was burning through all floors of the hotel. It is certain that those on inside court rooms of the third, fourth, fifth and sixth floors were in locations which were untenable, either in the rooms or corridors, shortly after the fire in the lobby was well started. The odds against successfully living through the holocaust in these rooms were tremendous, although most of those who lost their lives on these four floors were found in the corridors. On all floors there were rooms undamaged by smoke or heat, protected by closed wood panel doors and transoms.

The toxic effects, if any, of the artificial leather seats in the cocktail lounge and coffee shop did not contribute to the loss of life.

This is the largest loss of life reported to the Fire Record Department of the N.F.P.A. in a hotel building erroneously considered to be "fireproof" throughout. For this reason the post-fire effect on the traveling public, hotel managements, building and fire officials, architects and others has deep significance.

Conclusion.

From the mass of factors of errors of omission and commission, many of which are under study and are not yet fully reported by the several investigations in progress in Chicago, several emerge which are of immediate importance to the public.

Some factors are negative, some are positive, and it is impossible to summarize the preliminary conclusions which can be reached in the first few days following the destruction and loss of life at the LaSalle Hotel without considering both:

1. This loss of life should be the final answer to manufacturers, architects, interior decorators and designers who continuously resist all attempts to limit the use of highly combustible interior-finish building materials. Certainly, had not the highly combustible nature of the interior finish in the cocktail lounge given the fire its original impetus, it could easily have been confined to the upholstered wall seats.

2. While the exact cause of the fire in the suspended combustible ceiling of the cocktail lounge may never be determined, the fact that this and other concealed spaces in the room were not protected by automatic sprinkler or automatic fire alarm systems was responsible for delay in discovery of the disastrous fire which ensued.

A cast iron stringer of one of the two open stairways between the second and third floors cracked, and the wood window frame opening into the interior court burned out.

3. Had any of the myriad of building and fire inspectors who must have inspected the LaSalle Hotel throughout its existence discovered the two openings cut into the passenger elevator shaft adjacent to the cocktail lounge, it is entirely possible that the draft necessary to keep the fire smouldering in the concealed ceiling space and walls of the cocktail lounge would not have been possible. These openings, visible to the inspector only from the INSIDE of the elevator shaft, as was the lack of masonry behind the wood panelling above the elevator doors on the first floor, played a large part in the rapid spread of fire and heat. Their discovery after the fire should point an important lesson to all inspection authorities.

4. Loss of life might not have occurred from the fire, large as it was on the first and mezzanine floors, had self-closing doors been provided in the corridors at the head of each flight of the non-combustible, open stairways in locations which might be described as the inside corner of the series of rooms on the upper floors known as Nos. 46 and 47. (See floor plan.) Full enclosure of the open stairways would have been best solution, but retroactive requirements are difficult to sell to owners, if not outright impossible to enforce legally. Some way must be found to legally require owners to make their properties safe for the public, who refuse to follow good practice of their own volition.

5. Disregarding all structural deficiencies which contributed to the loss of life in the LaSalle Hotel fire, the cumber-

some process of dispatching a fire alarm to the fire department (the policy of this and other hotels), had disastrous effect. Whatever the exact passage of time may have been before the alarm was given to the fire department by the hotel, in this instance it was too long. When fire companies arrived promptly after being summoned, flames were shooting from the street windows of the cocktail lounge and the lobby was a mass of flames. The fact that cranks, drunks and other disorderly persons are prone to turn in false alarms from a hotel must not be a deterrent to finding the necessary solution to the problem of giving fire departments an even

Chicago Tribune.

Guests tied bedclothes together to lower themselves to balconies from upper floor rooms of the LaSalle Hotel. No one was injured in using this means of escape.

An interior view of a room in which the transom was left open. This photograph is typical of hundreds of rooms in the LaSalle Hotel as they appeared after extinguishment.

The wood panel doors and transoms were effective when closed. An undamaged room on the fourth floor opposite the open stairway landing and the burned out wood window opening into the interior court in the background.

break in extinguishing fire in its incipient stage in hotels and other properties.

6. The absence of a local alarm in the corridors, which could have been operated from the switchboard room, contributed to the loss of life.

7. There is no doubt that the provision of automatic sprinkler protection for the corridors of the hotel (without any other important action) would have enabled many of those who died to live. Occupants were forced or driven by panic to leave their rooms and died of suffocation or smoke inhalation in the corridors. The Chicago Fire Department, once on the scene, "knocked the fire down" in good time, though too late to save those who were aroused too late to escape by the heated and smoke-filled corridors.

8. Some way must be found, without unnecessarily disturbing the traveling public, to make certain that each guest shown to a room in a hotel knows his way out of the building in which he trusts his life, however temporarily. When corridors are full of smoke, lights at exits (however safe the corridor may otherwise be) will be obscured.

9. The exterior fire escapes, while used without injury in this fire, were useful only because of the largely fire-resistant character of the building. The inside enclosed stairways did not open directly to the outside of the building at the ground floor level, and their use would have brought guests or employees into the center of the raging fire on the first and mezzanine floors.

The reports of the various investigating agencies, when completed, will be made available to the N.F.P.A., and such additional information or corrections as are required in the light of subsequent knowledge of this unexpected disaster at the LaSalle Hotel will be made available through our publications.—Ed.

Curtis O. Grimes Ridley 39.

Dubuque, Iowa, Hotel Fire.

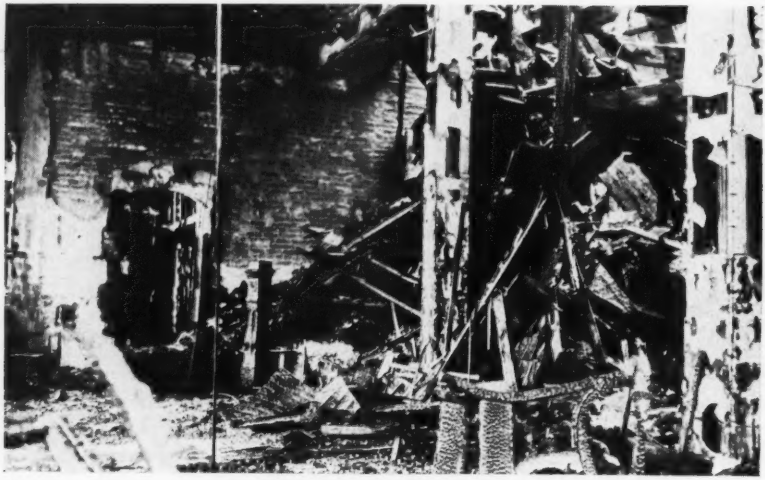
By James K. McElroy,
N.F.P.A. Engineer.

A fire which cost the lives of fourteen men and five women, and seriously injured twenty other guests of the Hotel Canfield, Dubuque, Iowa, in the early hours of June 9th, 1946, occurred just three days and four minutes following the holocaust at the LaSalle Hotel in Chicago. The tragic similarity of many factors in these recent hotel fires in which there was loss of life is of more than academic interest to the public, whose lives and property are exposed to human and structural failures which are within the limits of common sense protection.

A coldly technical report is not enough, while standing in the ruins of the Hotel Canfield, watching firemen carefully probing beneath tons of debris for scarcely recognizable bodies which may still be buried. The Dubuque Fire Department, and all who came to their assistance, rendered heroic service to their community and to the traveling public temporarily and horribly dependent on their skill. The odds at the Hotel Canfield were overwhelmingly against the fire department when they "rolled" at 12:39 A.M. on June 9th, as they will be against other fire de-

Associated Press.

The 50-year-old, brick-joisted section of the Hotel Canfield, Dubuque, Iowa, was a funeral pyre for several guests shortly after midnight, June 9th, 1946. Flames were shooting out of the first floor entrances to the Red Lounge and lobby when firemen arrived.



Acme.

Lack of protection at the doorway in the brick wall in the background permitted fire to spread from the Red Lounge of the Hotel Canfield to the lobby. Both rooms had highly combustible fibre board interior finish. The open wood stairway to upper floors started at the newel post in the center of the photograph.

partments whose communities do not take the necessary steps to give them an even break in providing structurally sound buildings, adequate automatic sprinkler or fire alarm protection, and trained hotel personnel who know what to do when a fire emergency arises.

For the fifty years of its existence, the open wood stairway to the three upper floors of the unsprinklered, ordinary brick-joisted section of the Hotel Canfield had been an invitation to any rapidly burning fire in the first floor or basement to involve the corridors in heat, smoke and flame and trap those occupants of the hotel who were not immediately cognizant of their danger.

The New Addition.

When the 6-story fire-resistive annex was built in 1925, there was constructed an interior, non-combustible stairwell with safe passage to the outside at the ground floor and with automatic fire doors on the openings into it. During the fire the doors on this stairwell automatically closed. At the time of the investigation it had not been determined whether or not this shaft was used for escape purposes after the heavy doors had latched shut. There was no indication of heat or smoke in this stairwell following the fire.

Normal access for guests to the hotel rooms on the second, third, fourth, fifth and sixth floors of the fire-resistive section from the hotel lobby on the first floor of the brick-joisted section was either by a passenger elevator in the lobby (in a sub-standard enclosure) or the open stairs in the four-story section. Access to the fifth and sixth floors of the fire-resistive section was from elevator landings in a frame, ironclad passage built above the roof of the four-story combustible section. Corridors from the old to the new section were continuous on all floors. The corridors were protected with automatic fire doors at the wall separating the brick-joisted and

the fire-resistive sections, except for an unprotected opening in the first floor and in the basement, but as it happened neither unprotected opening contributed to the loss of life or the spread of fire out of the lobby or the lounge. Following the Cocoanut Grove disaster, the Dubuque building official required that additional exits to the outside be provided from the Red Lounge on the first floor, which were later installed by the owners, and would no doubt have been used to save many lives had the Red Lounge been crowded with customers at the time the fire occurred.

Origin and Spread.

Investigation of the fire disclosed that it was the practice of the bartender of the Red Lounge bar of the hotel to require waitresses to collect cigarette butts in paper napkins left on table tops and deposit such refuse in a paper container in a small closet on the street side of the bar pending later disposal. In accordance with Iowa law, the bar had closed at midnight on Sunday night. At 12:10 A.M. four young people came in to play the juke box. They noticed a crackling noise, similar to the gnawing of a mouse, which seemed to come from the direction of the closet. One of the young men also smelled smoke and investigated. On opening the closet door he discovered that the wall was burning behind the paper carton used for cigarette butt disposal.

Initial efforts to extinguish the fire by a patron with a wet towel and by the hotel manager, using a portable extinguisher, were unsuccessful. The fire spread rapidly out of the closet to the highly combustible fibre board interior finish of the bar room. The Red Lounge had been "modernized" several years ago by the installation of the fibre board glued to 3/8-inch plaster board, which in turn was nailed to suspended 2 x 4's. The concealed spaces above the suspended ceiling and the closet spaces in the lounge were not protected by automatic sprinkler or fire alarm systems.

The substitute night clerk on duty reported that he first noticed the fire from the unprotected door opening in a brick wall into the Red Lounge from the lobby of the hotel. The manager attempted to warn guests on the upper floors. A telephone alarm from the hotel was received at fire department headquarters at 12:39 A.M., which was fifteen minutes or more after the fire was discovered. After telephoning the alarm, the night clerk escaped unharmed by descending basement stairs off the lobby, passing through the base-

Hruska.

One man lost his life on the second floor landing of the exterior fire escape shown in this photo. Fire swept out the entrance to the Red Lounge directly beneath the escape.

ment and to the outside through a rear exit in the fire-resistive section of the hotel.

The lobby of the hotel, also in the old section, had likewise had its interior finish "modernized" with a different type, though also highly combustible, fibre board, which permitted flames to spread rapidly over its surface. The spread of fire is reported to have been extremely rapid from the Red Lounge through a doorway to the lobby of the hotel, so rapid that when the first company of the Dubuque Fire Department arrived fire was belching forth from the street entrances to the lobby and Red Lounge.

Rescue Imperative.

The "invitation to death" which for years had existed in the unsprinklered building with the highly combustible fibre board interior finish and the open combustible stairway, had to be accepted by nineteen persons on the night of the fire. It was immediately apparent on the prompt arrival of the first fire company that many of the occupants were still alive and that life saving was of primary importance before actual fire-fighting operations could begin.

A second alarm was transmitted by police radio at 12:42 A.M. and all remaining city apparatus, all off-shift firemen, all firemen in the city who were on vacation, and two off-shift fire alarm headquarters operators responded. In all fifty-six men were on duty at the fire, including seventeen firemen who had rejoined the fire department since V-J Day. Countless civilians, the police department and National Guardsmen assisted in rescue operations which were imperative the moment the fire swept up the open wooden stairway from the lobby to the upper floors. There was insufficient manpower in the Dubuque fire department for fire fighting and rescue operations to proceed simultaneously. The only member of the Dubuque Fire Depart-

Associated Press.

Rescue of a woman trapped in her fifth floor room in the fire-resistive section of the Hotel Canfield. Passage of heat and smoke into the corridors of the fire-resistive addition prior to automatic operation of labeled fire doors made the corridors untenable. Thirty-seven persons were rescued, using ladders, from both the old and new buildings. Twenty-seven persons jumped to safety in fire department life nets.

Hruska.

The 50-year-old, four-story, brick-joisted section on the left. Two frame-iron-clad passages above the roof of the four-story section connected the elevator and the fifth and sixth floor corridors. Few transient occupants were familiar with the location of enclosed non-combustible stairs or the exterior fire escape, easily accessible from the corridors of the fire-resistive section of the hotel.

ment not at the scene was the fire alarm operator on duty at alarm headquarters.

Firemen and many helping hands using life nets saved twenty-seven persons. Ladders were employed to rescue thirty-five of the 129 permanent and overnight guests. Many escaped by using the safe exterior fire escape on the rear of the adjoining fire-resistive section. An exterior fire escape on the street side of the four-story brick-joisted section could not be used, as flames broke through the entrance to the Red Lounge directly under it. One man died in an attempt to use this means of escape, and another died just inside his window which opened directly on to the fire escape at its second floor landing. Several jumped from second-story windows to the ground.

The Attack.

A period of approximately 15 minutes elapsed after their arrival before firemen were able to make an attack on the inferno of fire sweeping through the older section of the building, but they eventually brought the fire under control. Dubuque's water supply was good, water was taken from circulating 8-, 10- and 12-inch mains from a 20-inch supply. Six pumping engines, an aerial and two ladder companies were in action. Nineteen 2½-inch hose lines from the engines, and two 2½-inch

Hruska.

A view of the Hotel Canfield, Dubuque, Iowa, following the fire which cost 19 lives. Note the outside fire escape at the rear of the six-story, fire-resistive section which was safe to use until the corridors were filled with hot gases and smoke. A grandmother lost her life and that of her grandchild when she refused to jump into a life net from her third floor corner room in the old section.

lines from hydrants were laid. Five deluge sets were in operation at the fire. Eighty-five pounds residual pressure at the pumper intakes was noted during the fire.

Loss of Life.

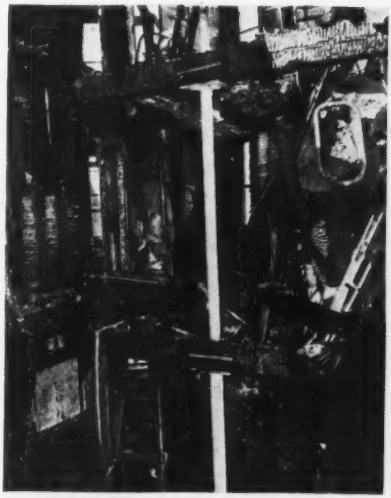
Following the 2½-hour battle to bring the fire under control and the search for bodies could begin, it was found that lives had been lost in both the combustible and fire-resistive sections of the hotel. The body of a woman patron, present when the fire was discovered, was found under the debris of the Red Lounge. Most of the loss of life occurred in the upper floors of the four-story section, either from burns or asphyxiation. Fire raging up the open stairway in the older building mushroomed, driving heat and smoke into the corridors of the fire-resistive section of the hotel until the fusible links in the fire doors operated to close all but one of the fire doors. One woman was found dead in the corridor of the fifth floor, just inside the fire door separating her from the frame, ironclad passage to the elevator. This fire door was wedged open with luggage, which indicated that she had tried to get out of the building the way she came into it, without knowledge that there was a fire escape which would have been safe for her to use less than 75 feet away around a corner at the end of the fifth floor corridor. A man was found dead in a third floor room of the fire-resistive section adjacent to a light court in which all windows, both in the older and newer walls of the court, were protected with metal sash and wired glass. Doors to rooms off the corridors in the fire-resistive section were wood paneled, with metal ventilating grilles. In those outside rooms in which the doors and transoms were closed there was very little evidence of smoke or fire damage. Corridors on the fifth and sixth floors were encrusted with soot and condensation marks to a level of

approximately 5 feet above the floor, presenting an appearance similar to the corridors in the Hotel LaSalle. The condition of the corridors is considered proof that the fire doors which were located in the passages from the burning wood-joisted section of the building did not operate quickly enough to enable guests unfamiliar with the location of the safe fire escape and the safe, interior, non-combustible stairway enclosure, to use them

Common Sense Protection.

Without question, the guests who lost their lives in the Hotel Canfield disaster trusted their lives to those who had jurisdiction over their safety. The vulnerability of the brick-joisted section of the building to destruction by fire from whatever cause, once under way, is easily recognized by the merest tyro in the fire protection and fire prevention profession. Little did the hotel owners realize that their "modernization" program of a few years back, which was responsible for the installation of highly combustible interior finish materials in the lounge and lobby, would only increase the vulnerability of the older building to a fire which would spread throughout the building with lightning-like rapidity. There is no doubt that the installation of automatic sprinkler protection for the four floors and basement of the 50-year-old building would have had a very high probability of extinguishing the fire in the lounge in its incipient stage. Sprinklers in the corridors alone would have made it possible for the guests in the older section of the building to find a place of refuge.

Even with the probability of a flash fire in the highly combustible fibre board interior finish installed in the lounge and lobby, had an automatic fire alarm system been provided which would inform hotel personnel that fire existed in the structure, all guests might have easily made their way to safety, provided they had been informed on checking into their rooms that the building offered two safe means of egress totally aside from the open stairways and the unsafe fire escape over the entrance to the Red Lounge.



Press Association.

The gutted interior of the four-story brick and wood-joisted section of the Hotel Canfield. The amount of debris was so great that it was only after days of searching the ruins that firemen were sure that no more corpses remained.

Those who have placed reliance on ordinary automatic fire doors to prevent loss of life have reason to be skeptical as a result of this fire. In this case smoke and hot gases passed through doorways before the fire doors closed, and one door was blocked open.

Meeting of Board of Directors.

Boston, June 3, 1946.

Present.

George W. Elliott, Chairman
Richard E. Vernor, President
David J. Price, Past President
Alvah Small, Past President
Hovey T. Freeman, Secretary-Treasurer

A. L. Brown	H. E. Newell
Russell Grinnell	C. W. Pierce
W. F. Hickey	H. E. C. Rainey
H. L. Miner	A. H. S. Stead
A. J. Mullaney	Lloyd T. Wheeler

Percy Bugbee, General Manager

Business Transacted.

1. The report of Chairman Elliott to the annual meeting was reviewed and approved.

2. The report of Treasurer Freeman to the annual meeting was reviewed and approved. Treasurer Freeman and General Manager Bugbee reported informally on progress in connection with the proposed pension plan and advised that a formal plan will be presented for consideration by the Board at its next meeting.

3. The Board decided to recommend to the annual meeting the election of Charles B. Mackinney of Providence and Henry A. Fiske of Providence as honorary life members.

4. Communications with respect to provisions of the National Electrical Code from the American Water Works Association, the International Brotherhood of Electrical Workers, the Fluorescent Lighting Association, and the U. S. Conference of Mayors were discussed. Chairman Small of the Electrical Committee was asked to bring the subject matter of these letters to the attention of the annual meeting at the time of presenting the report of the Electrical Committee to the Friday afternoon session, June 7th.

5. It was voted to hold the next meeting of the Board at the Squantum Club, Providence, R. I., at 10:00 A.M. Monday, July 15th, and to accept member Russell Grinnell's gracious offer to act as host for this meeting.

Board of Directors' Letter Ballot.

Places of Outdoor Assembly.

In accordance with authority voted at the 1945 "legal" annual meeting, the 1945 report of the N.F.P.A. Committee on Places of Outdoor Assembly (A.S.A. Z-20), was circulated by the Executive Office to all N.F.P.A. members with the July, 1945, News Letter. As a result of this circulation, numerous revisions in the standard were made and a revised text was submitted to the Board of Directors and approved for adoption as an N.F.P.A. standard April 10, 1946. The new edition is available in separate pamphlet form from the Executive Office.

Loss of Life by Fire in Industry.

By E. B. Gerry.

One of the great benefits of fire prevention and fire protection in industry is the greater safety to employees. For more than a century, the efforts of manufacturers in making their properties safe from fire have helped simultaneously to make working conditions safe. Today it is rare for a life to be lost in an *ordinary* fire in an industrial plant.

This is quite in contrast to the early days of industry prior to modern fire protection. Back in 1874, before the introduction of automatic sprinklers, a fire flashed over oily lint in a mule spinning room of a Fall River cotton mill and took the lives of 23 employees. An even worse tragedy occurred in 1911 with the famous Triangle Waist Company disaster in New York City. Here again there were no automatic sprinklers. Conditions were extremely congested and fire spread rapidly over large quantities of flimsy cotton cloth in cutting and stitching areas. Panic immediately prevailed. Exits were jammed and 148 died.

The principal reason that fires like these are rare today is the great effectiveness of the automatic sprinkler. The experience with sprinklers has shown conclusively that the chance of an employee losing his life in a sprinklered manufacturing building of *ordinary* occupancy is so remote as to be almost negligible.

Why then do we currently have loss of life in industrial plants? Because, during the last 25 or 30 years, new hazards have been introduced in the form of processes using flammable liquids, flammable gases, combustible dusts, hazardous chemicals, or other hazardous materials. This has increased the possibility of flash fires which sprinklers cannot be expected to immediately control, or of explosions, against which sprinklers do not afford protection.

As these processes came into use, special forms of protection were developed and adequate standards for installation, operation, and maintenance were worked out. However, safe control of the hazardous process and proper maintenance of safety devices necessarily fall into the hands of employees. In other words, a human element problem enters the picture.

Human element failures — instances where employees did something they shouldn't have done or failed to do something they should have done — have been important factors in approximately half of the fatal fires in Factory Mutual plants. Undoubtedly a similar ratio would hold for the country at large. This certainly indicates that exceptionally thorough instruction and training of the employees who work with a hazard is vital. They must be made to appreciate that failure to observe prescribed precautions may prove costly — to the plant, to other employees, and to themselves.

Probably the best way to emphasize the more important life hazards is to give specific examples, reporting briefly on fires or explosions that actually cost lives and then indicating basic preventative measures. With that in mind, let's turn to

This article was presented as a paper at the Fiftieth Annual Meeting of the Association, Boston, June 3-7, 1946. The illustrations are selected views from motion pictures shown at the meeting at the conclusion of the paper. The author is an engineer of the Inspection Department, Associated Factory Mutual Fire Insurance Companies, and the photographs show tests at the Research Station of the Factory Mutual Laboratories.

experience. Here I might indicate that all of the experience is not from Factory Mutual records. Reports and information from N.F.P.A. and from other insurance companies have been very helpful.

Flammable Liquids.

Flammable liquids are by far the most frequent cause of loss of life in industry. Fires have flashed across exposed liquid surfaces and caused fatal burns. Oil under pressure has escaped, found a chance source of ignition, and then exposed nearby workers to a veritable flame-thrower attack. Vapors from low flash point liquids have been allowed to collect in manufacturing areas or inside of ovens or dryers, and fatal explosions have followed. Employees have inadvertently saturated their clothing, while using flammable liquids for cleaning, and then become human torches after contact with a chance ignition source.

One of the most outstanding examples of loss of life due to flammable liquids is the R. M. Hollingshead disaster in Camden, New Jersey in August, 1940. Here large quantities of naphtha, alcohol and gasoline were used in the manufacture of polishing wax, rubber cements, lighter fluid, and leather dressings. Mixing tanks had open covers and ventilation was totally inadequate to prevent the accumulation of flammable vapors. Electrical equipment was not explosion proof and probably an electric spark provided ignition. The resultant explosion and fire claimed nine lives. Some were trapped amid flaming debris. Others had their clothing ignited and died from resulting burns. Three were blown from the building by the explosion. Flames not only destroyed several plant buildings, but also spread to a nearby block of dwellings and left 60 families homeless — causing a total of $2,000,000 damage.

The more important lessons are readily evident. Closed containers to prevent escape of vapors, adequate ventilation to carry off vapors which do escape, explosion-proof electric equipment for hazardous areas of the type involved.

Concentrations of flammable vapors in process equipment present a similar hazard. Ovens or dryers handling stock coat-

What happens when a 50-gal. drum of gasoline is involved in a fire. Imagine what would happen if this were inside a plant near employees!

ed with finishes containing flammable solvents become danger spots if they do not have proper ventilation arrangements. Last year, at a large Detroit automobile plant, for example, ineffective distribution of ventilation resulted in a vapor pocket near one end of a long, steam-heated dryer handling an upholstery fabric coated with a nitrocellulose dope. A static spark touched off the vapor mixture and a severe explosion resulted. Three employees standing near one end of the dryer were seriously burned, two fatally. As a minor consequence, compared to the loss of life, the dryer was demolished and total property damage amounted to $25,000.

This is good evidence of the need for making *certain* that ventilation provided for process equipment is adequate — both as to total amount and to distribution throughout the equipment. Flammable vapor indicators have proved very useful for checking this feature.

Although secondary to controlling the medium that's going to burn or explode, eliminating ignition sources is also important. Electrically caused fires can be largely prevented by requiring explosion-proof equipment where flammable vapors may be present. Mechanical sparks and open flames should be eliminated. Under conditions where static sparks might be generated, adequate grounding of equipment is needed and in certain areas, such as those where fabrics are coated, the possibility of static may be reduced by proper humidification.

Piping systems containing oil under pressure deserve special attention when considering hazard to employees. If a break occurs in the system, the liquid may be atomized or released as a spray, and in this form even a fairly high flash point oil will ignite readily. Fuel oil systems, lubricating oil systems, and die casting systems are three typical examples. Of these, die casting probably is the worst offender.

At a New York die casting plant, for example, a valve stem blew out of a high pressure hydraulic oil line at a die casting machine and oil under 1000 lbs. pressure spurted from the opening and was immediately ignited by nearby gas burners. Burning oil set fire to the clothing of a number of employees. Seven were seriously burned; four died.

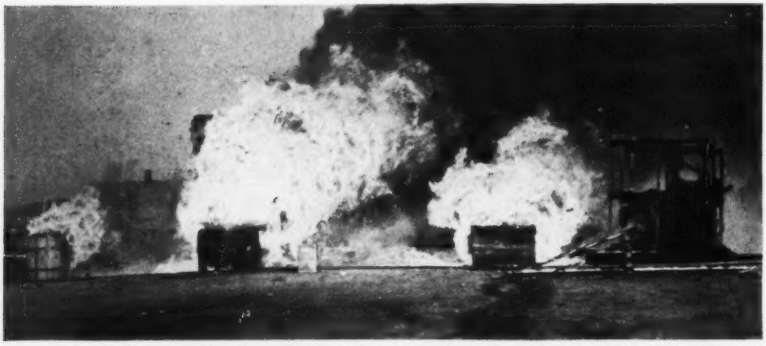
How to prevent? For die casting, the best solution is to use a hydraulic liquid which does not support combustion. For fuel oil, lubricating oil, and similar systems exceptional maintenance is needed, and readily accessible shutoffs, including remote control valves outside of probable fire areas should be provided.

Flammable Gases.

Unsafe use of flammable gases is another ringleader that has cost lives. Fuel gases, including city gas, natural gas, propane, and butane, have figured in many accidents. Other industrial gases such as hydrogen and acetylene also present hazards.

Probably the simplest source or trouble is leaks. Last winter at a Detroit electrical plant propane escaped from a corroded underground pipe and flowed through a pipe tunnel to a pit below a manufacturing building. Two employees entered this pit to get a motor stored there. Finding the light out, one of the men struck a match and touched off a violent explosion. Both of the employees were very badly burned, one died the following day.

This experience points to the need for especially careful installation and maintenance of piping. Buried gas piping should be protected against corrosion by



A typical pyroxylin fire. When the nitrocellulose material is heated gases of decomposition pour off and when ignited a violent explosion occurs.

a tar coating plus an asbestos felt wrapper. Where piping passes through walls it should be enclosed in larger pipes as protection against settlement. After the piping gets inside the building it should be well supported and properly guarded against mechanical injury. Once again, emergency shutoffs accessible from the outside are needed.

Another site for gas explosions is gas-fired process equipment such as ovens, dryers, boilers, and tempering furnaces. There have been unfortunate experiences in large units where safety controls were not properly maintained. Likewise, lives have been lost from explosions in units which were felt too small to justify automatic controls and where safety was entirely in the operators' hands.

To illustrate the latter, at a Chicago metalworking plant, an employee attempted to light a small, gas tempering oven after a brief shutdown. Had he opened the oven doors — as proper procedure required — he would have found that gas had accumulated in the oven due to a burner valve being only partly closed. Ventilation was by natural draft only and a damper in the exhaust stack was found closed — after a violent explosion had claimed the operator's life.

The basic thought in preventing such accidents is to prevent unburned gases from collecting in the equipment. This can best be accomplished by providing positive safety ventilation with a motor-driven blower (independent of any recirculating system), suitable combustion safeguards, and automatic controls to see that ventilation and gas supply work together. Adequate explosion vents to relieve any explosions which do occur are likewise advisable.

A number of fatal accidents have occurred while employees were trying to rectify faulty operation of gas-fired equipment. Without citing examples, the very fact that equipment is not performing properly should serve as a clear warning. Exceptional care is needed to avoid the accumulation of unburned gases during repair periods. Pre-ventilation of equipment before lighting becomes especially important.

Chemical Processes.

Chemical processes are also bad offenders. They entail a wide variety of hazards and available records do not single out any individual processes that merit more emphasis than others. Typical fatal accidents

during recent years have resulted from such things as ignition of heptane vapors leaking from a system used in castor oil extraction, overheating of a still used to produce trichloroethylene, polymerization of vinyl acetate in a storage tank inside a building, and rupture of a container of sulphuric acid when compressed air was used to transfer the liquid between tanks. Due to such variety, it is difficult to lay down broad principles of safety other than the need for exceptional maintenance of equipment and unusually thorough training of employees who work at the process.

Hazardous Materials.

From chemical processes let's go to hazardous materials. Pyroxylin is an outstanding example. Experience with this material has been fairly good during the last few years because plants have observed good standards for safe storage and use. As a warning against any relaxation, consider a tragic experience of some years ago in which twenty lost their lives.

Fire started in an uncovered trash barrel containing pyroxylin scrap, presumably as a result of careless smoking. Nearby pyroxylin material decomposed from the heat of this fire and gases of decomposition rapidly filled one end of the room, and formed an explosive mixture with air that was ignited by the fire in the barrel. A tremendous explosion demolished one end of the building and a huge accompanying burst of flame not only fatally burned workmen in the room but also enveloped nearby wooden dwellings. Several occupants were trapped and died.

Pyroxylin should not be stored in manufacturing areas, but should be kept in special non-combustible storage vaults. Explosion venting windows and close-spaced automatic sprinkler protection are also recommended.

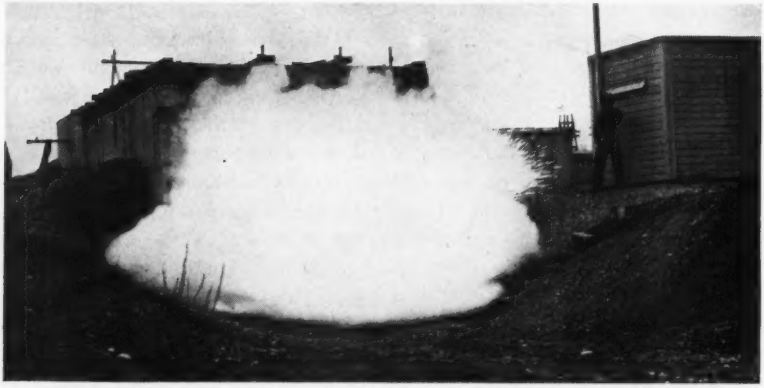
Combustible Dusts.

Fatal dust explosions have occurred with many types of combustible dusts varying from oldtimers like wood and grain dust to the more modern metallic dusts, aluminum and magnesium. Although harmless in appearance, all of these dusts pack tremendous power under certain conditions.

Take grain dust, for example. A few years ago a small fire broke out in an unsprinklered fan house adjoining a 5-story brick-joisted malting plant. Hose streams stirred dust deposits into a cloud and the resulting dust-air mixture was ignited by the fire. A terrific explosion wrecked the upper floors of the building and falling debris killed two, injured thirteen others.

The primary remedy is, of course, to provide adequate dust removal facilities so that dusts are not allowed to lodge on interior building members, but are safely collected in a collector located outside the building. Explosion venting windows are also desirable because they will relieve pressure and greatly minimize the extent of damage.

Turning to magnesium dust, even more elaborate precautions must be taken. Shortly before the end of the war there was a very serious accident at a New England plant producing magnesium castings. A small fire at a grinder touched off a violent explosion in the dust collecting system servicing the grinding operation. Six men in the vicinity were fatally burned and a number of others badly injured. Several fires broke out following the explosion and total damage of about $50,000 resulted. The fault here was in the dust collecting system in which dust was carried through ductwork for some distance before it was quenched in water. Safe collecting arrangements provide for thorough



An aluminum dust explosion. Less than one pound of aluminum dust produced this flash from the explosion tunnel. It is wiser not to be standing in the path of such a flash.

washing of dust-laden air close to the dust-producing operation. Excellent housekeeping to prevent any accumulation of dust on beams, pipes, light fixtures, etc., is also important.

Combustible Fibers.

Combustible fibers present another hazard worth mentioning and this — unlike some of the previous — is a hazard that has been with us for many years. Cotton is, of course, the fiber most frequently associated with loss of life — and flash fires over cotton the most common manner of occurrence.

At a Georgia duck mill an employee tossed an armful of card strips over his shoulder and happened to strike and break a drop-cord type incandescent light. The hot filaments ignited the cotton and the man died of the burns he received.

There's no doubt about the need for eliminating all possible sources of ignition in cotton preparatory and similar areas. Old-fashioned, drop-cord type lighting should be replaced by guarded, dust-tight lights, preferably located at the ceiling. All electrical equipment should be well maintained to prevent short circuits and arcing. Other sources of cotton fires, such as matches, smoking, and mechanical sparks, should be similarly guarded against.

Sometimes a slowly developing cotton fire can be dangerous, too. By this I mean such a fire as might develop in a bin of opened cotton. In a recent example in a New England mill, fire started in opener equipment. Flames were blown through a cotton conveyor system to a stock bin and were buried by following cotton. When the fire was discovered an hour or so later, four fire brigade members started to pull out the cotton to get at the seat of the fire. Access doors for unloading the bin were well below the surface of the cotton and the four men literally "excavated." After they had made a substantial hole, the roof of cotton started to cave in and the combination of the falling cotton and draft conditions was just right to promote a flash fire over the entire surface of the hollowed-out space. The blast of fire occurred so suddenly that the men had no chance to escape it and all were killed.

This fire points to the fact that fire can strike suddenly in unanticipated ways.

The method of working to discover the fire was entirely normal. In this instance the delivery system to the bin should be arranged to deliver cotton away from bin doors, heat and gases should be conducted outside the building by natural ventilation. Under these conditions sprinklers in the bin might be expected to control the fire.

Fire Fighting.

Certain phases of fire fighting present hazards whether performed by employees or public firemen. We've seen one instance in this cotton fire just described. In the grain dust explosion mentioned a few moments ago, a fireman was one of those struck by flying debris and killed. These experiences suggest that fire fighters should exert extreme caution in areas where there are combustible dusts or loose fibers subject to dislodgement. Other particularly dangerous situations from the point of fire fighting are those where flash fires could occur, closed areas where there might be an accumulation of unburned gases, or where fires must be fought under heavy smoke conditions. The last has long claimed lives and a study of the toxic effects of gases produced in fires has long been contemplated by the N.F.P.A. Late in 1945, the Safety Research Institute made the N.F.P.A. a gift of $6,500 to defray at least part of the cost of such research. A committee headed by John L. Wilds, President of the Protection Mutual Fire Insurance Company, was formed in January, 1946, and we look forward to some valuable reports from them in the future.

Helicopters for Forest Fire Control.

David P. Godwin,
Assistant Chief, Division of Fire Control, Washington Office,
U. S. Forest Service, Chairman N.F.P.A. Forest Committee.

It's an exciting field of thought — the employment of helicopters in fire control and other forest activities. Hopes long cherished but often dim are being renewed as technological advances take on the shape of reality. As the development of the hovering type of flying machine—known to the aeronautical profession as rotary-wing aircraft — moved forward by slow and painful steps, foresters began to dream of the revolutionary effects it might have upon their present ways of doing the field job. It seemed like a vehicle built to order. In the early 1930's we had a few opportunities to use the autogyro over some of the western areas. But the autogyro was a transitional type and did not free itself of the basic elements of the airplane. Now comes the helicopter.

Development of the Helicopter Principle.

The pure helicopter principle has engaged scientific thought for centuries—Leonardo da Vinci designed one in the fifteenth century. But he, like hundreds of successors in this field, failed because of the lack of a sufficiently powerful force to lift or propel the machine. So it was not until well after the invention of the gasoline engine and some years after the first airplane flights that rotary-wing aircraft left the ground. In 1922 Bothezat, a Russian scientist, under contract with the United States Army, built his helicopter and made several short but successful flights. This was the real beginning of the practical development. The autogyro entered the field for a period and then under

Sikorsky military helicopter R-5 which, with enlarged cabin, will be the basis for the Sikorsky commercial four-place model.

an appropriation from Congress in 1938, the Army Air Forces—acting for the military branches and a few civil agencies (including the Forest Service)—invited bids for design competition. Later, out of this action came the Sikorsky helicopter. In 1942, the Sikorsky XR-4 made its first flight and was the forerunner of the many war-inspired helicopters now in the air and performing in the main like grown-up airships and not toys.

During the past 2 or 3 war years there has been a ferment of design and production activity in this aircraft field, and now it is accelerated by the race to reconvert to peacetime requirements and compete in the commercial market just around the corner. Today there are about 50 aircraft organizations engaged in the manufacture or development of helicopters. This dramatic new development in air travel has excited the public interest; and due to Sunday-supplement articles, semiscientific magazine promotion, and the zeal of advertisers' artists, the whole thing has been overpromoted. Many people look forward confidently to buying soon a two-passenger job for about the cost of a flivver, or a chance to ride in a 50-passenger airline helicopter. For such people disillusionment is ahead.

Developments have reached a stage, however, where it can be said that the helicopter is the most versatile type of flying machine known to man, capable not only of vertical rise and descent within an area slightly larger than that swept by its rotors, but also of hovering, climbing, gliding, and flying forward, backward, or sideways.

Uses in Forested Areas.

Because it can land and take off in very restricted areas, the helicopter could deliver men and supplies in thousands of spots throughout forested areas, such as flat ridge tops, small meadows or clearings, and in canyon bottoms. The Forest Service, if sufficient funds were provided, could extend the number of airplane landing fields beyond the approximately 90 now in use on the national forests, although topography would soon limit the number of available sites. Furthermore, the clearing

and leveling of such sites is an extremely costly process. On the other hand, if perfected rotary-wing aircraft were available, there would be almost no limit to the number of small landing spots already provided by nature or which could be inexpensively prepared. With such an air-ground transit system, small well-trained and equipped crews could be transported to spots at or near small fires very quickly after their discovery.

The helicopter would also have many other forest uses. On large fires men could be shuttled back and forth between fire camp and fire line, and prepared food taken to the fire fighters on the job. For various types of observation such aircraft has no equal. These include detection of fires, scouting project fires from the air, and prevention and law enforcement in areas where incendiarism gives trouble. Helicopters would be ideal for search and rescue work, livestock and game counts, and for survey and administrative travel in connection with range and timber management.

Most of the federally protected forest areas lie in the western mountains and are rough and relatively inaccessible. Millions of dollars have been invested in roads and trails constructed primarily and in some cases purely for fire protection. The large annual maintenance cost of these ground-transportation systems is an additional financial burden. A well-planned and skillfully managed helicopter operation conceivably could provide a degree of protection justifying a reduced road-building program and abandonment of some existing routes.

Given certain assumptions as to helicopter performance, such as pay load, hovering and service ceilings, cruising range, speeds, and operating costs, it should be relatively easy to prepare a helicopter fire-control plan. Actually, several of our western regions have selected sample areas and worked out on paper and maps the location of hub or operating points, degree and time of coverage, suitable dispatching schemes, the elimination of existing facilities and personnel, and have set up rough comparisons of the costs of the respective systems.

Prospective Designs.

The aeronautical principle of the helicopter has been proven beyond doubt, but mechanically there is a different story. Much has yet to be done to remove the "bugs" from the complex mechanisms. Corrections and refinements must come in rotor-blade construction, power transmission, and the hub design and assembly, and lighter and stronger metals must be employed. Another important and interesting time-taker in this feverish evolution is the matter of arrangement and number of rotors, which the aircraft designers call "rotor configuration." A struggle is on between the advocates of these different helicopter conceptions. A great number of configurations have been worked on, but basically there seem to be about a dozen. No doubt these will shake down to less.

We laymen are easily lost in these aeronautical competitions and prophecies as to which rotor schemes will survive, but it is possible to state oversimply what the present outstanding patterns are. There appear to be about six: (1) Single rotor with tail rotor to counteract torque as in the Sikorsky helicopter; (2) two rotors mounted on either side of the fuselage but clearing as exemplified by the Platt-LePage machine; (3) two rotors mounted on either side of the fuselage but synchronized and intermeshing as demonstrated by the Kellett design; (4) two rotors mounted in tan-

dem (fore and aft) but clearing as illustrated by the Piasecki; (5) two rotors mounted in tandem but overlapping in sweep as exemplified by the Magill; (6) two coaxially mounted rotors (one superimposed above the other) as in the Hiller or the Bendix.

Together or singly, P. A. Thompson and I have visited the plants of six leading helicopter manufacturers to make a rough survey of the progress being made, to discuss with these men the possible forest uses of rotary-wing aircraft, and to fly in some of the models. Also, for a long time we have had contact with industrial designers and engineers and with officers of the Army Air Forces helicopter development section. We have familiarized industrial producers with our fire problems and fire-control methods which we believe the helicopter can improve upon, and invited them to demonstrate — under flying contract if necessary — what these machines can really do in the actual ground and air conditions presented by our rough mountain terrain. One or more will probably respond to this invitation during the early summer of 1946.

As is generally known, the three Sikorsky models were the only helicopters produced in quantity for the A. A. F. As roughly graded by their power, these are the R-4, 180 horsepower; the R-6, 235 horsepower; and the R-5, 450 horsepower (photograph, p. 34). Several hundred of these were built and flown. The R-4 is a very light reconnaissance type and hardly suitable for any western forest work. The R-6 may have some applicability, but the R-5 is the most powerful, has fine performance, and is the prototype upon which the first Sikorsky commercial model, the S-51, will be based. The following data on the S-51, which will probably be produced in moderate quantity in 1946, help to visualize what the machine is like and can do.

Performance.

(In NACA Standard Air)

High speed at sea level, miles per hour	103
Cruising speed at 65 per cent brake horsepower, miles per hour	80
Minimum flying speed, miles per hour	0
Maximum rate of climb at sea level, feet per minute	1,200
Hovering ceiling, feet	3,500
Service ceiling, feet	13,000
Fuel consumption (cruising) approximate 28 gallons per hour.	

Load Distribution.

(Cruising Range 150 Miles)

	Pounds
Fuel (70 gal.)	420
Oil (6.7 gal.)	50
Residual fuel and oil	30
Pilot (1)	170
Passengers (3)	510
Baggage	70
Useful load	1,250

Weights.

	Pounds
Gross weight (design)	4,900
Useful load	1,250
Empty	3,650

Changing the employment of this useful load to a distribution more suitable to our fire-suppression crew needs, the 500 pounds of fuel could be reduced to 350, thus releasing 150 pounds to be devoted to personnel and equipment. This would cut the cruising range down to about 100 miles but would permit the transportation of four men (including pilot) and 220 pounds of equipment. This is merely an example and leaves out of consideration the flying, hovering, and landing problems inherent in altitude.

The Piasecki PV-3 is, to my knowledge, the largest American helicopter. Its fuselage is 48 feet long and according to Mr. Piasecki it has flown with 10 passengers—unusual lift for a 550-horsepower engine. The model has been accepted by the Navy. Equal or greater weight-carrying capacities, we learn, are being projected by other

The Kellett military model helicopter XR-8, which employs two 3-bladed intermeshing rotors.

builders. The biggest job we have heard of is the German helicopter, Focke-Achgens, powered with two 2,000-horsepower engines, which was in development during the war and the design of which was discovered and reported by the British Intelligence Mission. It was to mount two 55-foot rotors laterally, weight 16 tons, lift 5 tons, and was intended to carry tanks and trucks across rivers and to hoist such loads as bridge girders into place.

Costs.

What will helicopters cost? We ask that question frequently, but there is no definite answer. It is quite understandable that manufacturers can as yet set no prices. Great expenditures for research and engineering have gone into present models which have been virtually hand-made. Even though all makes still have "bugs" to be worked out, it is likely that three or four leaders will go into moderate commercial production sometime in 1946 and at that time will quote. As production progresses, costs will decline and probably reach a point where helicopters can be had for prices 30 to 50 per cent in excess of airplanes of equivalent pay load and other comparable characteristics. The difference in cost between the two types of aircraft will be the price that customers will have to pay for the unique performance which can be had in no other way. Because of the helicopter's inherently intricate mechanisms and vulnerable members, it is likely also that operation and maintenance costs will exceed somewhat those of comparable airplanes.

Helicopter pilots and mechanics are specialized, and due to the newness of this technology, few in number. They will come from the personnel of the Army or the manufacturers. In the whole country there are probably not 200 competent pilots. However, there is a surplus of airplane pilots, and questioning a number of

authorities turns up a sort of average opinion that 30 hours of training is sufficient to make a helicopter pilot of a capable airplane pilot.

Tests in National Forests.

We now have high hopes for an early comprehensive field program of test and demonstration of the adaptability of the helicopter to forest work under actual forest conditions. Last summer and fall many contacts were had with officers of the A. A. F. relative to the Forest Service proposal of military aid during the 1946 season, involving an experimental as well as operational project. The experimental project will include two phases: (1) Experiment and test to develop, if possible, a technique of effectively dropping fire-suppression materials from airplanes and (2) test and demonstration of the suitability of helicopter operation as a part of the fire-control system. The latter only is pertinent to this article.

The whole plan was approved October 23, 1945, and a directive was issued by the Assistant Chief of Air Staff, assigning to the Continental Air Forces the task of setting up the projects as a cooperative endeavor with the Forest Service. For the helicopter project March Field in southern California was selected as the center of operations, and the Angeles National Forest as the proving ground. In December, 1945, two R-6 machines with crews were assembled at March Field and at this writing four more R-6's are due to arrive and two R-5 machines are expected to be assigned. These are, of course, the military types but will serve fully to demonstrate the adequacy of helicopter performance under those conditions.

The work plan provides for a series of tests to determine the limits of combinations of conditions, including load, topography, altitude, weather, and cover, within which satisfactory performance can be obtained. These will be combined with or followed by tests of practical application of the helicopter in the many and varied proposed uses in Forest Service work. The results of these operations, which could be provided us only by the A. A. F., should put us far ahead in our knowledge of how we can employ this new scientific development.

So far helicopters have not flown our forested areas. Flights in a few comparable conditions have been cited, but comparisons and simulations are not definitive; and until these airships maneuver over our actual terrain and do the things we require of them, we will not know. The first tests with existing models may not be entirely conclusive, but if they are only fairly successful, we feel confident that in a reasonably short time the pending improvements in the mechanical elements will round out a vehicle that will mark a turning point in the progress of forest transportation.

Airport and Aircraft Fire Protection.

By George H. Tryon, III,

Engineer, National Fire Protection Association.

A review of the hangar fire losses reported to the N.F.P.A. during the period 1923 to June 1, 1946, will indicate some of the pertinent fire facts about airports which will get us started on the subject in a very realistic manner.

The 187 hangar fires reported caused a total loss of $53,200,000. This means that the average loss per fire is $285,000. Military hangar fire losses average the highest — over $1,800,000 per fire. Commercial and municipal hangars cost $70,000 each time one burned. Private hangars averaged nearly $30,000. Expressed in tabulated form we find this:

Military Hangars	24 fires	$43,297,000
Commercial (Municipal)	126 fires	8,851,000
Private	37 fires	1,081,000
Total	187 fires	$53,229,000

These high losses per fire largely reflect the high unit cost of the aircraft involved. Thirteen hundred and nine aircraft were destroyed by these 187 fires; an average loss of 7 planes per hangar. While structural damages were heavy, they constituted, with only a few exceptions, a minor portion of the total dollar loss. Of the 1309 aircraft destroyed, ninety per cent had full or partially full fuel tanks, resulting in flammable liquid fires regardless of the initial cause.

Fires in all unsprinklered hangars averaged $309,000 each, while fires in sprinklered hangars averaged only $2,000.

Seventy per cent of all airports suffering hangar fire losses reported to the N.F.P.A. were outside municipal fire protection zones and possessed no organized airfield protection. In 85 out of the 187 cases there was no water supply available, or water systems were so weak as to be ineffectual. In 15 additional cases, water had to be drafted from nearby rivers, wells, creeks, streams, or irrigation ditches, delaying and impeding fire suppression.

In only three cases were box fire alarm systems available. In 80 per cent of the instances (where information on the transmission of the alarm was available), the telephone was the sole means of calling assistance. Delayed alarms contributed to the spread of fire in 52 of the 187 losses, while long fire department runs from nearby municipalities delayed getting water on the fire.

Forty-two per cent of these fires started on or in aircraft inside the hangars from hazards associated with the maintenance and storage practices, as follows:

Gasoline spills releasing vapors	18
Ignited by electrical arc	8
Draining aircraft inside hangar	3
Ignited by static spark	3
Ignited by soldering operation	2
Ignited by blow torch	2
Welding operations on aircraft	16
Short circuit of aircraft electrical system	10
Cleaning aircraft with gasoline	8
Electrical light bulb on extension cord ignited airplane fabric	4
Heating of dope to speed drying action	4
Accidental release of aircraft flares	2
Preheating of aircraft engines	2
Starting of aircraft engines inside hangar	1
Unknown (started in aircraft)	15
Total	80

This article is based on an address given at the 50th Annual Meeting of the National Fire Protection Association, Boston, June 5, 1946. Statistical tables have been added to clarify the text. The information is based on a study conducted in the Executive Offices of the Association.

One of the factors determining the type and size of aircraft fire-fighting equipment required is the type and size of the aircraft using the flying field. Other considerations include the air traffic, the topography, the pilot experience, outside protective agencies available, weather conditions, flight obstructions, and maintenance and storage activities.

As opposed to this, only about 19 per cent were caused from fire hazards associated with the structure itself:

Heating defects		27
Overheating of heating unit	9	
Heating units exposed to flammable vapors	7	
Backfire or explosion of unit	4	
Defective oil burners	4	
Inadequate clearance of heating units from combustible materials	2	
Coal stove overturned	1	
Electrical defects		8
Short circuit in wiring	2	
Faulty extension cord	2	
Battery charging unit breakdown	1	
Overloading of circuit	1	
Unexplained defect	2	
Windstorm caused collapse of structure, resulting in falling timbers which caused release of gasoline in aircraft tanks and ignition		1
Total		36

An additional 13 per cent were occasioned by such outside factors as:

Incendiary or suspicious fires	7
Aircraft crash into hangar	5
Lightning strikes on hangars lacking lightning protection	4
Set by children at play	2
Bomb explosion	1
Sparks thrown by passing locomotive	1
Flying brands from trash fire	1
Vehicle fire	1
Total	22

The balance, 26 per cent, were divided between smoking, overt acts of human carelessness, and unknown, as follows:

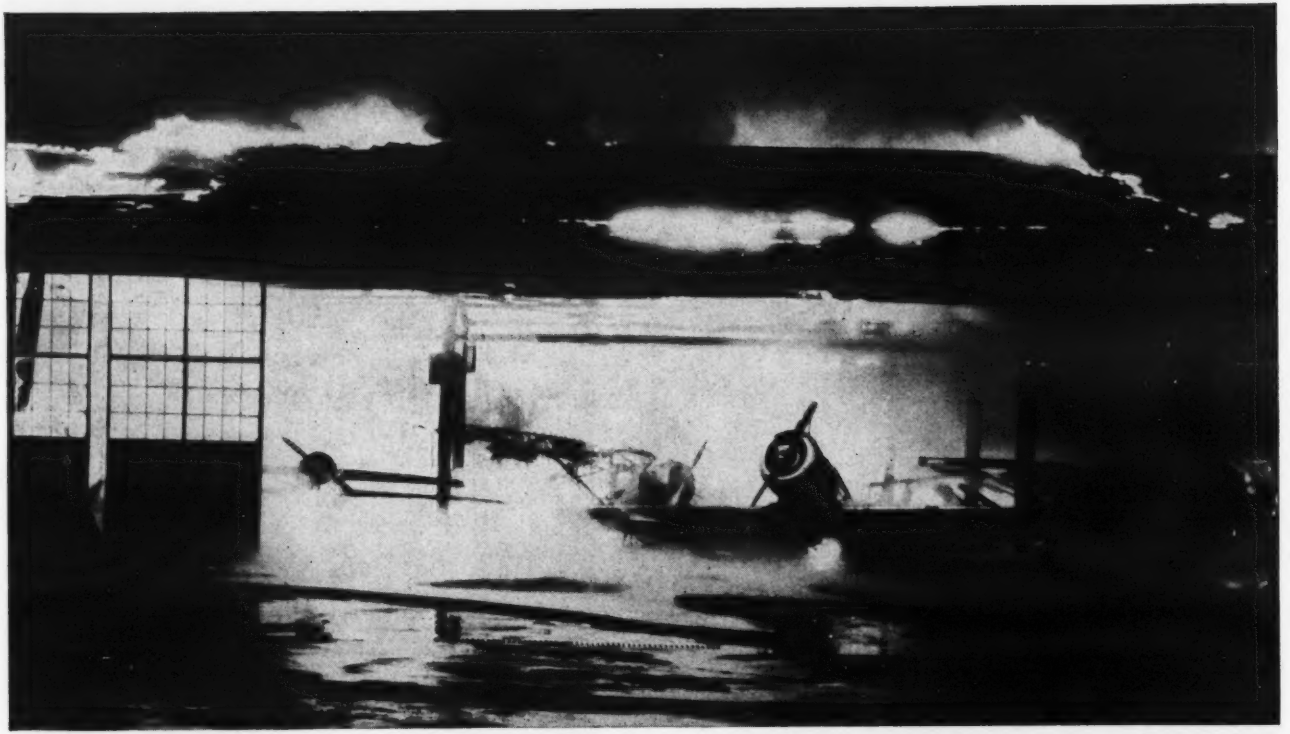
Associated with smoking		8
Careless disposal of cigarettes	4	
Careless use of cigarettes	2	
Use in hazardous locations against rules of establishment	2	
Spontaneous Ignition		3
Of oily rags	1	
Unexplained	2	
Ignition of nitrocellulose film		1
Overheating of soldering iron		1
Repairing blow torch		1
Heating oil on stove		1
Heating wax on stove		1
Unknown		33
Total		49

These hangar fires occurred around the

Acme.

March 8, 1946: Newark, N. J. Three DC-3C airplanes were destroyed in this fire, which also caused heavy damage to the unsprinklered hangar. A mechanic was draining gasoline from the drain-cock of one of the transport planes inside the hangar when vapors ignited from an electrical spark from an extension cord. Loss: $75,000 for aircraft; $75,000 for hangar; $10,000 for miscellaneous equipment.

the flying field. Other considerations include the air traffic, the topography, the pilot experience, outside protective agencies available, weather conditions, flight obstructions, and maintenance and storage activities.



Press Association.

Sept. 25, 1945: Wichita, Kansas. Twenty-eight planes crowded with overlapping wings into a 30,000-sq.-ft. unsprinklered hangar were destroyed by a fire attributed to a short circuit in the battery cables of a small, fabric-covered aircraft. The fire went beyond control, before city equipment reached the scene, because of full fuel tanks, wooden roof construction, and the lack of readily available water supplies. Loss: $495,000.

Acme.

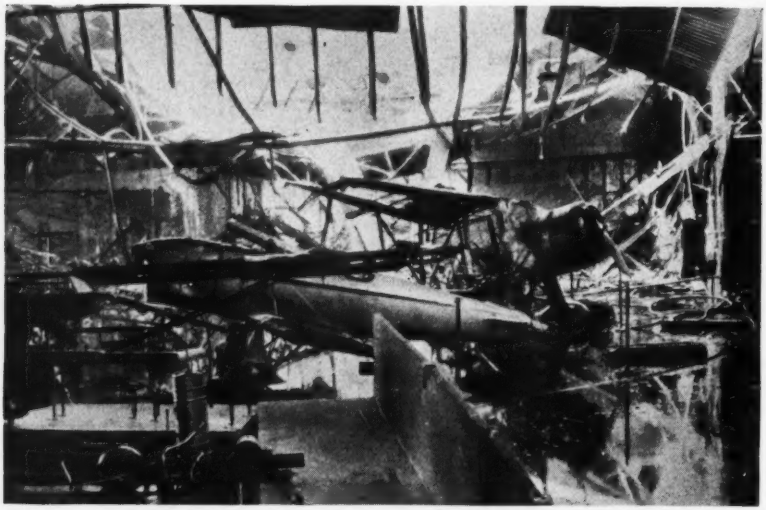
March 6, 1945: Near Dayton, Ohio. A cargo plane crashed through the hangar door at flying speed when it went out of control at time of take-off. Superior construction (reinforced concrete) limited extent of structural damage, but impact and crash caused a general fire, destroying three planes, damaging six others, and killing eight men. Eighteen hose streams and 1,400,000 gallons of water were required to extinguish the flames, as magnesium parts caused repeated flashbacks in the vapor-laden atmosphere.

clock. Twenty-seven started between midnight and 6 A.M., 41 between 6 A.M. and noon, 51 between noon and 6 P.M., and 36 between 6 P.M. and midnight (in 32 cases the time was not given on the report). In 133 cases, the airport was operating, while in 54 it was not. In the latter instances, watchman service was provided in only 20 cases and in the balance detection of the fire was dependent upon the casual observation of passers-by or neighbors.

These, then, are the statistics. The question logically follows, what is the N.F.P.A. going to do about it? At this writing we have definite plans. It involves a six-fold approach to studying the overall problem. Assuming that each reader is a manager of one of our ever-expanding network of airports, it would be possible to explain the proposals this way:

Is the airplane in your hangar, on your flight line, coming in on the base leg, fire safe? Can it be left overnight unattended, can it rev-up without catching fire, can it land with safety? Is your airport investment subject to loss from fire originating *in* an aircraft?

Does the airplane you service or store have a fire protection system of its own? Will an incipient fire in the power plant be snuffed out by the discharge of an installed fire extinguishing system? Are static ground wires provided and provision made for static discharge at the fuel tank filler nozzle? Is a battery cut-off switch provided to de-energize the aircraft elec-



Soundphoto.

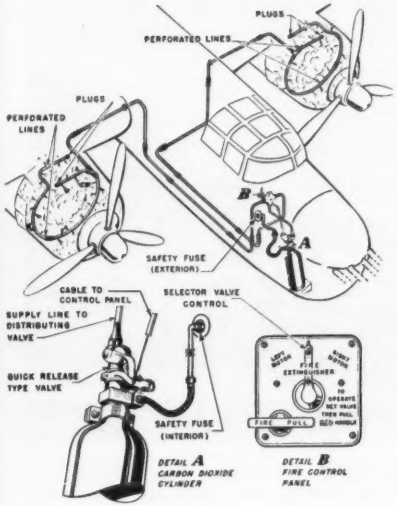
April 14, 1944: Glendale, Calif. An ordinary electrical outlet plug (presumed to have been disconnected) in an airplane dope spray room (otherwise completely equipped with vapor-proof fixtures) was the source of an electric spark which ignited a vapor-laden area when an unauthorized maintenance man attempted to remove the plug. The flames reached the hangar proper via the ventilating system and quickly destroyed seven planes. Loss: $105,000.

trical system? Is your airport investment subject to loss from the uncontrolled spread of fire from an aircraft?

What aircraft maintenance practices are employed and what is their significance from a fire prevention viewpoint? What rules are enforced for the drainage of fuel tanks on aircraft undergoing repair? Can flammable solvents be used to clean aeronautical equipment and what special precautions are observed? Are hazardous operations — welding, doping, carburetor testing, paint spraying, etc. — "cut-off" from each other and from general storage or repair by a suitable space (outside hangars) or a fire division wall (inside buildings)? Is your airport investment subject to loss from fire hazards incident to the maintenance and servicing of aircraft?

How do your aircraft storage practices look from a fire protection point of view? Are planes crowded into hangars with wing spans overlapping? Are fuel tanks full, presenting the hazards of a sweeping fire if ignition from any source involves the planes? Are fire lanes provided for aircraft stored out of doors? Is your airport investment subject to loss from fire because of unwise storage practices?

Now take a look at your physical facilities. What honest fire defense do you have? What fire protection is engineered into your structures? What extinguishing agents can be brought to bear on a gasoline-based fire of 400 gallons, 800 gallons, 1500 gallons, or more? What is your fire defense manpower and how is it trained? Where is this manpower at 9.52 P.M., 1:45 A.M., 7:17 A.M., 3:35 P.M. — around the clock? How are they notified of a fire? Is your airport investment subject to unnecessary loss from fire because you have failed to provide the proper construction,



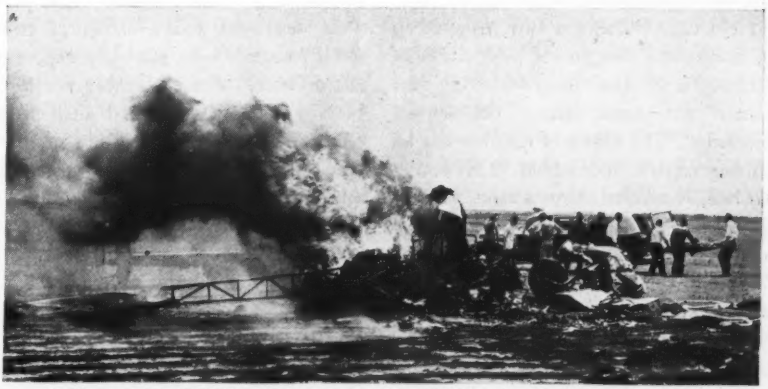
(Left) A typical installation of an aircraft power plant fire extinguishing system incorporates perforating tubing to reach fire zones. Manual control levers are provided in the cockpit. Smoke detectors can flash a warning to the pilot. Carbon dioxide is the most generally used medium, but there has been some experimentation with methyl bromide.

to maintain it in a fire-safe manner, and failed to consider the rudiments of fire protection?

It only takes one crash fire, poorly handled, to kill carefully developed public confidence. Oh, yes, people excuse accidents, but not negligence! One pilot burns to death when his plane ground loops on take-off while you rush to the scene in front of a Sunday crowd with a one-quart-size extinguisher, and, brother, you can close your airport. Both the Army and Navy found the need for special aircraft fire fighting equipment and their investment paid huge dividends in terms of *life* saving. You may be a small operator — or a big one — but you have this problem if you are operating at all.

In other words, the approach to the problem is from the following six viewpoints:

I. Aircraft Fire Prevention and Operation
II. Aircraft Fire Protection
III. Fire Hazards of Aircraft Maintenance
IV. Fire Hazards of Aircraft Storage Practices
V. Airport Fire Protection
VI. Aircraft Fire Fighting



April 7, 1946: Wichita, Kansas. Faulty piloting (maneuvering into the wind during a steep climb when approximately 50 feet in the air) caused this crash at time of take-off. The pilot and co-pilot were killed by impact but the only passenger miraculously escaped. Airport fire fighters were on hand with a specially developed crash truck to accomplish prompt rescues. Aircraft loss: $60,000.

Acme.

January 28, 1946: Near Oklahoma City, Okla. A 13-acre hangar building was heavily damaged by a fire originating near the fuel booster pump test stand when vapor, escaping from the gasoline supply hose, was ignited by an ordinary electric floor heater. Lack of either fire cut-offs or automatic protection permitted the fire to spread, and ten persons were trapped and died on a mezzanine floor. Loss: Structure, $500,000; equipment, parts and other contents, $1,800,000.

In this article we have only touched lightly on a handful of some of the problems in each category.

Already in 1946, there have been nine major airport fires reported to the N.F. P.A., causing losses estimated at $4,351,-000. The largest and most serious, at Tinker Field near Oklahoma City, resulted in ten deaths and was caused by ignition of gasoline fumes emanating from the fuel booster test stand when the supply hose failed. The source of ignition was an ordinary electric floor heater. This particular hangar covered thirteen acres, was unsprinklered, and lacked fire division walls for the special hazard maintenance work conducted therein except for the paint spray operations. Inasmuch as this field was one of the largest Army Air Forces stations, ample water supply and a highly trained fire department were readily available, but, even with these advantages, aid was called from Oklahoma City.

A fire during March, 1946, at a small municipal airport will serve to illustrate the other extreme. Here, lacquer and dope fumes were ignited by a coal stove. The fire flashed throughout the hangar and was through the roof by the time fire equipment reached the scene. Five planes were destroyed and a string of twenty small hangars were seriously exposed — and no water — except a meager collection of rain water in a railroad ditch 50 feet below the airport level. Only the fortunate fact that the town fire department had a high lift suction booster pump saved the exposed property.

The urgency of the situation calls for action now. While no claims are laid to prophecy, it is evident that the future national welfare, economy, and security are closely allied with the future of aviation. Aviation cannot progress unless it achieves a degree of fire safety consistent with the hazards involved.

Pressure Release for Dust Explosions.

By Irving Hartmann.†

The damage caused by dust explosions depends largely on the maximum explosion pressure, the rate of pressure rise, and the duration of the excess pressure. During an explosion within a structure the pressure results chiefly from heating and expansion of the air and gases due to the heat of combustion. One practical means for limiting the pressure is to provide relief vents in the wall surfaces, through which the hot gases can flow out rapidly. The vents can be simply free or unrestricted openings, hinged or pivoted sash which swing outward at a predetermined internal pressure, scored glass panes, light wall panels, paper, metal foil or other diaphragms that burst at low pressures, or other similar arrangements.

The value of vents for reducing structural damage from explosions has long been recognized by research workers and by safety engineers, and their use is recommended in most of the dust explosion codes of the National Fire Protection Association. Recently a special N.F.P.A. Committee on Explosion Venting has been formed. One of its aims is to prepare a code that will "provide information on suitable methods of utilizing vents to release from buildings, rooms, bins, or equipment the pressure produced in dust, vapor or gas explosions, before it becomes sufficiently high to cause mechanical damage."

The factors affecting the explosibility of dust clouds and of the release of pressures in explosions are numerous and involved, and very little experimental work had been done[1,2] upon which the design and distribution of relief vents can be based. To extend this limited knowledge an investigation has been started recently by the Bureau of Mines. The results of the initial phase of this study have now been published.[3] This article is based on that work.

Scope of Recent Study.

The purpose of the tests being conducted by the Bureau of Mines is to determine the venting requirements for dusts of different explosive properties, to release explosions in equipment and structures of various dimensions, and to study the relative effectiveness of relief vents of several types.

Dusts studied so far include pulverized bituminous coal, wood flour, soybean protein, commercial cornstarch, basic phenol formaldehyde resin, milled magnesium, atomized aluminum, and stamped or flaked aluminum. The particle size of all samples was 90 per cent or more minus 100-mesh and 50 per cent or more minus 200-mesh.

The venting tests were made in a cubical enclosure or gallery of 64-cubic-foot volume, constructed of 2-inch, tongue-and-groove pine planking, reinforced with

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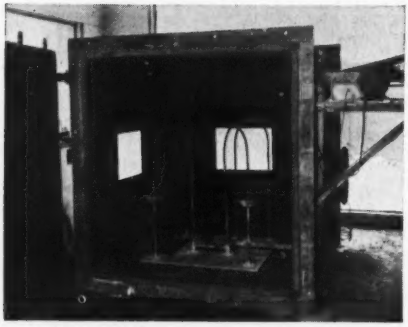
[1] Brown, Hylton R., and Hanson, R. L., *Venting Dust Explosions:* National Fire Protection Association QUARTERLY, April, 1933.

[2] Factory Insurance Association, *Determination of Dust Explosion Possibilities: Special Hazard Study 4,* Hartford, Conn., 1940.

[3] Hartmann, Irving, and Nagy, John, *Effect of Relief Vents on Reduction of Pressures Developed by Dust Explosions:* Bureau of Mines Report of Investigations 3924, 1946, 22 pp.



U. S. Bureau of Mines.

Fig. 1. View of 64-cubic-foot dust-explosion gallery.

steel angles along the outer edges, and lined on the inside with galvanized steel sheet. The gallery has four adjustable openings or vents, one in the top and one each on three sides. The fourth side of the gallery has a door set on vertical hinges, which is closed tightly against a sponge-rubber gasket during explosion tests. To facilitate work in adverse weather the entire gallery is housed in a large shed.

The dust used for forming the dust cloud in the gallery in most tests was placed in four hemispherical cups set above the gallery floor (see Figure 1). The dust was dispersed by directing a short blast of compressed air downward into the cups. Another mode of dispersion will be mentioned later. A high-voltage induction spark across a ⅜-inch gap near the vertical centerline of the gallery was used in some tests to ignite the dust clouds. In other tests ignition was accomplished by the timed flame of 15 grams of guncotton. To obtain pressure-time records of the explosions, special manometers of the diaphragm and sealed-spring type were mounted on the gallery walls; the manometers are equipped with photo-

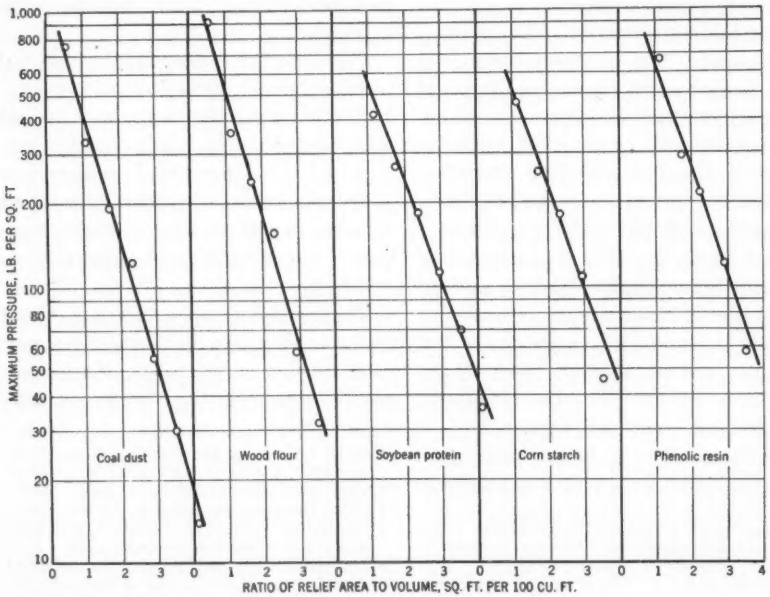


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Fig. 2. Effect of unrestricted relief vents on pressures produced by explosions of various dust clouds.

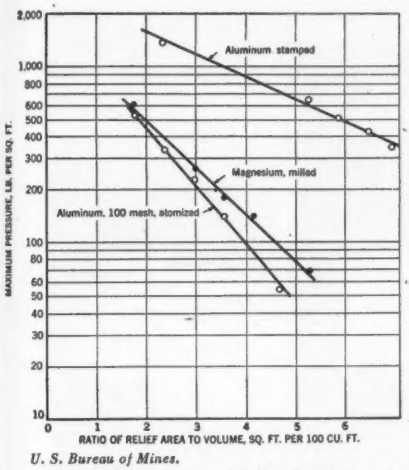
Aluminum, stamped
Magnesium, milled
Aluminum, 100 mesh, atomized
MAXIMUM PRESSURE, LB. PER SQ. FT.
RATIO OF RELIEF AREA TO VOLUME, SQ. FT. PER 100 CU. FT.

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Fig. 3. Effect of unrestricted relief vents on pressures produced by dust explosions of aluminum and magnesium powders.

graphic film on drums revolving at constant speed.

To insure safety of the operating personnel a very strict procedure was followed. All electrical circuits for effecting the dust dispersion and the ignition and for the recording instruments are controlled from a building distant from the gallery, and no one is permitted to remain within less than 40 feet of the gallery when a test is to be made.

Preliminary Tests.

To determine the optimum conditions for producing severe dust explosions in the gallery considerable preliminary work had to be done. As in all dust-explosion research, one of the great difficulties arose in the production of dust clouds of approximately uniform concentration. Another factor that required study was the proper location and timing of the igniting spark and guncotton flame. A third important variable was the amount of dust dispersed into the air. When compressed air was used to disperse the dust, the highest pressures were obtained at a concentration above the stoichiometric mixture, the latter being a mixture that contains just enough oxygen for complete combustion of all the dust. This is due partly to the non-uniformity of the dust clouds and partly to the fact that in the tests all the dust did not burn during the explosions.

Tests with Unrestricted Vents.

In one series of experiments the relation of the maximum explosion pressure to the area of a single unrestricted rectangular or square vent opening in a vertical face of gallery was determined. The width (horizontal dimension) of the opening was held at 18 inches and the length was changed in 3-inch steps. Ignition of the dust clouds was accomplished by guncotton flame. The results showed that for the dusts tested the relation of the pressure to the area of the relief vents, or rather to the ratio of the vent area to the volume of the enclosure (vent ratio), can be expressed by an equation of the form:

$$P = Ae^{-kr}$$

where P = maximum pressure, lbs. per sq. ft.
r = vent ratio, sq. ft. per 100 cu. ft.
A and k = empirical constants
e = base of natural logarithms (2.71828)

Another way of expressing the relation is:

$$\log P = \log A - 0.4343\,kr$$

where $0.4343 = \log_{10} e$

This means that if log P is plotted against r the resulting curves should be straight lines. That this is the case can be seen in Figures 2 and 3. The values of the empirical constants A and k are as follows:

	k	A
Coal dust	1.05	1,350
Wood flour	1.05	1,500
Soybean protein	.85	1,250
Cornstarch	.85	1,200
Phenolic resin	.85	1,400
Aluminum, atomized	.75	2,150
Magnesium, milled	.65	1,700
Aluminum, stamped	.30	2,950

The data show that the most violent explosions, that is, those most difficult to

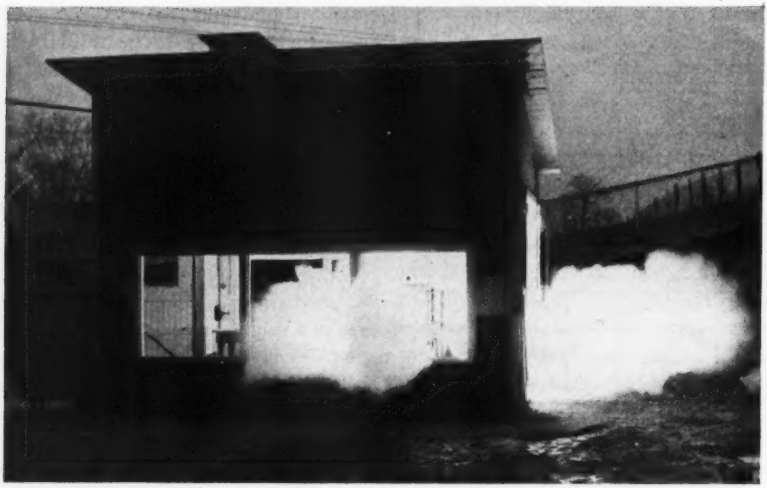

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Fig. 4. Atomized aluminum-powder explosion released through four vents in gallery walls.

vent, are developed by dust clouds of stamped aluminum powder. This was to be expected, because laboratory tests[4] had shown that such explosions develop high pressures at very high rates of pressure rise. Next in decreasing order of severity were explosions of milled magnesium powder, atomized aluminum (see Figure 4), phenolic resin, cornstarch, soybean protein, wood flour, and coal dust.

To illustrate the application of the curves in Figures 2 and 3, it can be seen, for example, that in this gallery a maximum pressure of 300 lbs. per sq. ft. was developed by the several dusts at the following relief-vent ratios:

	Sq. ft. per 100 cu. ft.
Coal dust	1.30
Wood flour	1.40
Soybean protein	1.60
Cornstarch	1.65
Phenolic resin	1.75
Aluminum, atomized, 100-mesh grade	2.60
Magnesium, milled*	2.65
Aluminum, stamped	7.60

*This powder was comparatively coarse; only 51.6 per cent by weight passed a 200-mesh sieve.

It should be remembered that these minimum requirements apply to unrestricted vents. Preliminary test results indicate that, in general, if vent openings contain diaphragms, explosion sash, or other restrictions, vents are needed of larger areas than shown above. Furthermore, it is not known yet whether vent requirements are the same for enclosures of greatly different size and shape than this test gallery. For these reasons the reported data must be applied with great caution, until further experimental information is at hand.

Effect of Ignition Source.

Past experiments and industrial accidents had shown that the nature of the initial dust disturbance and of the ignition

[4] Hartmann, Irving, Nagy, John, and Brown, Hylton R., *Inflammability and Explosibility of Metal Powders*. Bureau of Mines Report of Investigations 3722, 1943, 44 pp.

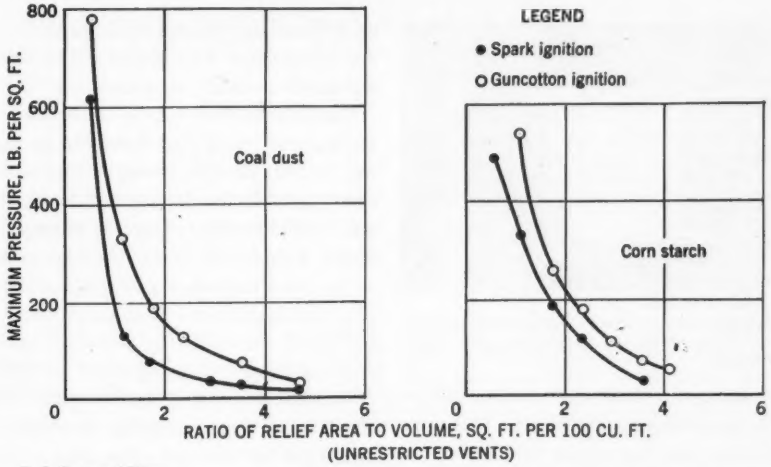

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Fig. 5. Comparison of pressures developed by dust explosions initiated by guncotton ignition and by spark ignition.

source have an important effect on the violence of a resulting dust explosion. Other factors remaining the same, the intensity of an explosion depends to some degree on the volume of the dust cloud that comes in intimate contact with the initiating flame or other heat source. This is illustrated in Figure 5, which shows that explosions of coal and cornstarch initiated by an electric spark, essentially a point source, were less intense than those ignited by fairly long flames of guncotton.

Although industrial dust explosions will rarely, if ever, be initiated by flame from guncotton, that convenient source of ignition was used in this study because it is easy to control and reproduce. In industrial practice hazardous incendive agents of like and of even greater intensity are encountered occasionally in flames of furnaces, in welding torches, in strong electric arcs, in gas flames, and the like.

Effect of Several Vents.

Various tests were made with aluminum and coal-dust explosions, in which unrestricted vents were used on two adjacent sides, on two opposite sides, on three sides, and on four sides of the gallery. In nearly all tests the maximum explosion pressures

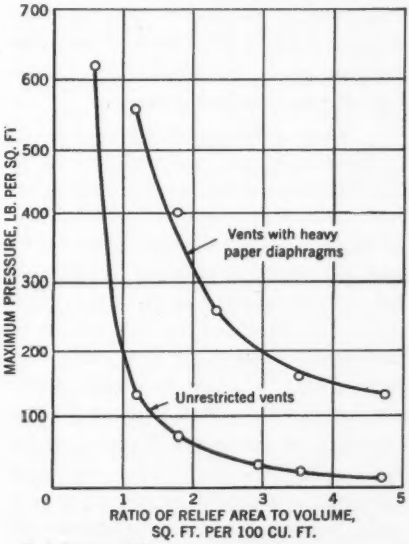

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Fig. 6. Relative effectiveness of unrestricted openings and of heavy paper diaphragms in relieving pressures from coal-dust explosions initiated by electric spark.

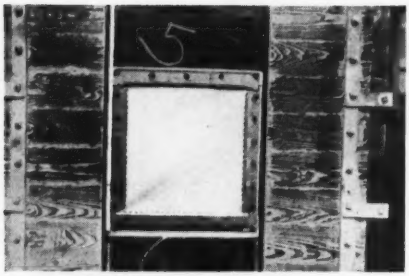

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Fig. 7. Arrangement of saw-toothed cutters along periphery of heavy-paper diaphragm.

with these arrangements were the same as with an equivalent single vent. This does not mean that like results would necessarily be obtained in much larger cubical enclosures or in galleries of other shapes. In fact, previous work in long, narrow galleries and industrial experience have shown that gas and dust explosions are often relieved more rapidly through several properly distributed openings than through a single relief vent, if the latter happens to be an appreciable distance from the source of the explosion.

Vents with Paper Diaphragms.

Relief vents are rarely unrestricted in industrial equipment, but the openings are sealed with paper, metal foil, or other diaphragms, which are designed to burst if an explosion occurs at pressures considerably below the breaking strength of the equipment. To determine the effectiveness of such sealed vents, tests were made with heavy (0.007 to 0.008 inch thick) paper diaphragm seals on an opening of the gallery. As can be seen in Figure 6, under these conditions much higher explosion pressures were developed at a given vent ratio than was the case with unrestricted vents. The reason for this is that in the latter case the efflux of gases from the gallery started immediately after the dust was ignited, resulting in rapid release of internal pressure, whereas in the presence of the heavy paper diaphragms a time delay was involved until the paper broke.

To facilitate the breaking of diaphragms at pressures lower than those corresponding to their normal strength, it is sometimes possible to place cutters along the outer periphery (see Figure 7) or near the center of the outside face of the diaphragm, so arranged that when an explosion starts in the equipment and when the pressure is still small, the diaphragm comes in contact with the sharp cutting edges and is broken or weakened so that it breaks rapidly. The effect of such arrangements on pressures developed by coal-dust explosions in the gallery is shown in Figure 8.

Swinging Panels or Doors.

To release pressures produced by explosions, hinged doors or panels are frequently used as vents in equipment. The panels are normally held closed by friction latches or by their own weight. In some installations the doors or panels are so heavy that they fail to swing open rapidly enough to

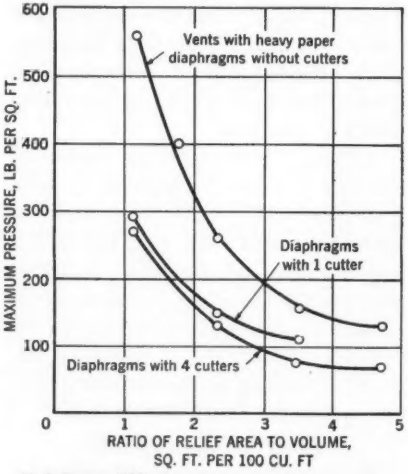

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Fig. 8. Effectiveness of cutters to facilitate rupture of heavy paper vent diaphragms on pressure relief of coal-dust explosions.

prevent structural damage. To determine the effectiveness of such devices a number of tests were made by attaching top-hinged doors without friction latches on a vent in a vertical face of the gallery. Light-weight doors of 1/16-inch steel and heavy doors of ¼-inch steel were tested on 12-in. x 12-in. and on 18-in. x 18-in. square openings. These openings correspond to vent ratios of 1.56 and 3.52 sq. ft. per 100 cu. ft. of enclosure. The dust explosions in these tests were initiated by an electric spark. The results are summarized in the following table, which for comparison also includes pressures produced in similar explosions with unrestricted vents and with vents sealed by heavy paper diaphragms without cutters.

Type of Vent	Maximum Pressures (lb. per sq. ft.) Produced by Explosions of— Coal Dust		Aluminum, Atomized, Fine
Vent ratios, sq. ft. per 100 cu. ft:	1.56	3.52	3.52
Unrestricted opening .	81	29	71
Heavy-paper diaphragm	292	158	205
Light swinging door .	101	36	161
Heavy swinging door .	—	55	232

These data show that: (a) relatively slow explosions of coal dust can be vented in the gallery as effectively by light swinging panels as by unrestricted vents, but that use of heavy swinging panels might result in higher pressures; (b) swinging panels relieve slow explosions at lower pressures than do heavy paper diaghragms; (c) in rapid explosions, such as of atomized aluminum powder, even use of light-weight swinging panels results in much higher pressures than are developed with unrestricted vents.

When hinged panels or similar swinging devices are used, some provision must be made to equalize the internal and external pressure immediately after the initial rapid outflow of the hot gases. In a number of tests this was not done purposely, and it was found that shortly after the panel closed shut following the outrush of gas, a negative pressure of the order of 800 lbs. per sq. ft. was developed in the gallery.

Further Research.

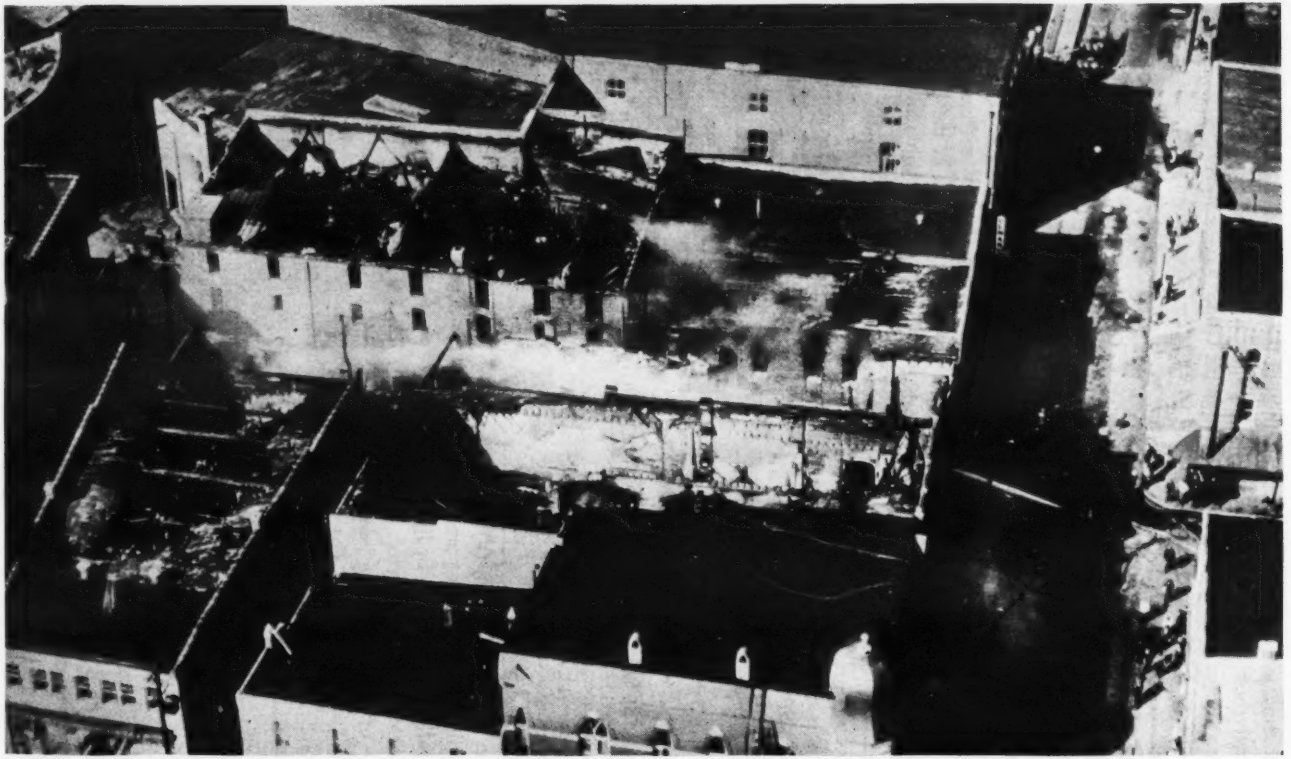
Two additional galleries of different sizes have been designed and constructed. By correlating test data in the three galleries, it should be possible to estimate venting requirements in structures of industrial scale.

Tests are in progress to improve the uniformity of dust clouds for the explosion tests. It has been found that by putting the dust in a bag or container set at the center of the gallery and placing a small detonator in the dust, good dispersion results when the detonator is discharged. These dust clouds can be ignited by the same methods that were used with the compressed-air dispersion.

Further tests are planned to study the effectiveness in releasing explosion pressures, of metal-foil diaphragms, of scored glass panes and of other commercial vents of various shapes and sizes.

By placing extensions on the galleries the venting of explosions in ducts will be investigated. Later, tests may also be made in simulated or actual dust-grinding mills, screens, and other industrial equipment.

It is also planned to make studies of the basic mechanism of dust explosions, their initiation and propagation. Coupled with the current experimental data, it is hoped that this information will lead to derivation of theoretical relations for computing pressure-release requirements and to better understanding of the general phenomenon of explosions.



Press Association.

Four mercantile buildings were gutted in Salisbury, Md., on March 14, as lack of exposure protection featured in the spread of flames. In remodeling wallboard had been used to close openings in a fire wall.

Recent Fires.

With the thought that current information on recent fires is one of the best clues to prevention activity, we present a review of a selected group of important and interesting fires reported to the N.F.P.A. Department of Fire Record during the past quarter.

March 1, 1946, Watertown, Wis., Malt House:

An old five-story malt and kiln house of brick and ironclad construction was heavily damaged by a fire originating in the top story fan room, presumably caused by frictional sparks from a slipping fan belt or a defective electrical motor. The fire was discovered at 12:30 P.M. by a neighbor as flames were observed to engulf a frame cupola, and the alarm to the local fire department was given by telephone. The fire spread rapidly through the upper portion of the kiln house, and additional help was summoned from five neighboring communities. As this assistance was received, flames had spread to an adjoining building and three adjacent similarly constructed structures. Hose lines, one brick fire wall, and a favorable wind helped to confine the damage to these buildings. A total of fourteen 2½-in. hose lines was used during the operation. Absence of automatic sprinkler protection, the age of the structures (erected in 1890), the exposure conditions and the lack of an aerial ladder truck were contributing factors to the spread of fire. Loss: buildings $157,775 (value $257,755); contents $134,000 (value $212,650); total: $292,775.

March 8, 1946, Newark, N. J., Hangar:

The fire hazards of aircraft maintenance operations inside hangars were vividly illustrated in this fire, which swept a steel and concrete, unsprinklered hangar and destroyed three DC-3 airplanes and miscellaneous equipment. A mechanic was draining gasoline into open pails from a fuel tank drain-cock of one of the aircraft when fire flashed over the entire area. It is considered probable that either a short circuit on an extension cord being used for inspection work on the same aircraft or a spark at the extension cord junction box ignited the vapor laden atmosphere. Eleven engine companies, four ladder companies, a crash unit, and auxiliaries responded to three alarms (the first at 6:23 A.M.) and used twelve hose streams and foam on the fire. Loss is estimated at $75,000 for the aircraft, $75,000 on the hangar, and $10,000 for miscellaneous equipment, totaling $160,000. (See photograph, page 41.)

March 14, 1946, Salisbury, Md., Business District:

The third major fire in this city since January 1st completely destroyed four mercantile buildings and seriously damaged four others before control could be accomplished. All the buildings involved were of ordinary, brick-joisted construction, two and three stories high, and, because of extensive remodeling, were mutually exposed. An eight-foot alley was the only break in what otherwise consisted of a single fire area of roughly 21,000 sq. ft. The fire started in the rear of a ladies' wear store, probably from a breakdown of electrical service cables which entered the rear wall four feet above ground. Three archways in a fire wall which had been closed with light wallboard allowed the flames to enter an adjacent department store, and unprotected window openings across the alley permitted the flames to enter a confectionery store and a combined furniture retail store and warehouse. Another exposed furniture store was also heavily damaged by fire, smoke, and water. A taxi driver discovered the blaze at 3:40 A.M., but delayed turning in the alarm until he picked up a police officer and drove to fire department headquarters. This delay, plus the lack of protection at horizontal

Heavy damage was sustained by this malt house in Watertown, Wis., on March 1, when lack of automatic protection and delayed discovery permitted the flames to involve three buildings in the plant group.

Removing wallboard had been used to close openings in a fire wall.

openings and stairwells, no automatic protection, and the need for assistance from six neighboring communities contributed to the spread of fire. Loss $250,000.

March 15, 1946, Emeryville, Calif., Electrical Equipment Plant:

Lessons in basic fire engineering can be illustrated by this fire which totally destroyed a block-long, two-story, unsprinklered plant which previously had manufactured electrical transformers and coils. The alarm was given through a street box by a passer-by at 11:15 P.M., and fire fighters responding found the plant so fully involved that little could be done to save the property. Lack of automatic sprinklers or alarms, no watchman service, no fire division walls, failure to cut off hazardous operations in a special room, flammable materials scattered throughout the building, open stairwells, unprotected steel frame beams for wood floor supports, and wood-joisted roof construction were the most obvious of the many deficiencies in the plant. These shortcomings were apparently tolerated by management despite the fact that the same company had experienced two other fires resulting in total losses in 1925 and 1937, according to local press reports. Fire fighters fought the blaze from all sides of the building and secured the assistance of the Oakland Fire Department, but the best that could be done was to hold exposure damages to the minimum ($2,000). The cause of the fire is attributed to failure of employees to turn off an electric bake oven located in the plant's paint spray room. Loss: Building $150,000; contents $219,000; total $369,000.

Oakland Tribune.

No sprinklers, no automatic alarms, no fire division walls, no protection for special hazards, plus carelessness of employees, resulted in a total loss to this California electrical equipment manufacturer on March 15.

An automatic sprinkler system turned off is of little value. Testimony to this fact can be observed in this picture, showing complete destruction of a grain mill in Alton, Ill., on March 16.

March 16, 1946, Alton, Ill., Grain Mill:

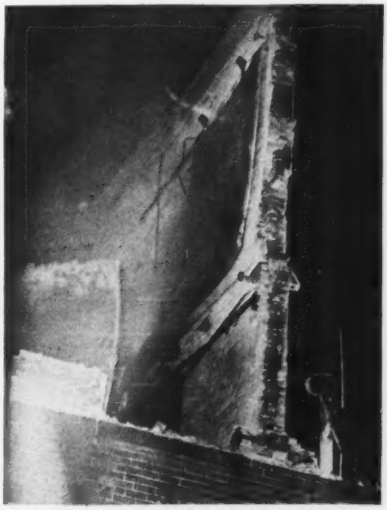
A 4:22 A.M. explosion in the dust-collecting room on the top floor of a seven-story and basement, sprinklered, brick-joisted grain mill caused a fire observed by two employees. It was 4:30, however, before a telephone call was received by the fire department, and the first equipment to reach the scene was manned by only three firemen. Two other fire trucks arrived shortly thereafter, but limited manpower restricted operations seriously until off-shift personnel and neighboring towns gave assistance. The flames traveled quickly through the building of origin via vertical openings and spread to an adjoining sprinklered mill building through the common dust-collecting room which violated the fire wall division between the two structures. Fire also communicated to a third adjoining, unsprinklered, reinforced concrete building at the third floor level through one unprotected opening which negated the effectiveness of the division wall and the fire doors on all other floors. Falling walls finally spread the damage to two other sprinklered buildings adjoining on a third side. Investigation of the fire showed that the sprinklers were shut off by an employee at an undetermined time after the explosion occurred, probably within the first seven or eight minutes. The fire department did not ascertain this and did not attempt to use the fire department connection to the sprinkler system. Loss: $1,484,000. (Property damage, $875,000; use and occupancy, $609,000.)

March 18, 1946, Suffolk, Va., Peanut Plant:

Employees left the premises after a normal day of operations at 4:30 P.M. The watchman was scheduled to begin his first round at 6:00 P.M. Outsiders (including the watchman on his way to work) noticed smoke pouring from the roof of the five-story, brick, ordinary wood-joisted, unsprinklered factory shortly after 5 P.M. The first telephone alarm, however, was not received by the fire department until 5:37 P.M. On arrival of the fire department the entire top floor was in flames and attempts made to carry hose lines through a stairway to the fifth floor were unsuccessful due to intense heat. High tension electric transmission lines hampered approaches with hose streams from ladder trucks on two sides of the building, and freight cars on a siding adjacent to a third side also handicapped close work. A fire division wall (12 to 24 in. thick) separated the factory (on the fourth side) from a fire-resistive type, five-story, unsprinklered peanut storage warehouse and satisfactorily prevented spread to the contents of this building. The factory, a one-story office and unloading platform, and all machinery and equipment therein were totally destroyed. Chief factors contributing to the loss were delayed discovery and alarm, lack of automatic protection, non-standard watchman service, poor housekeeping, severe dust accumulations, and inadequate fire department manpower and facilities for handling the well-advanced blaze. The cause was not determined, but old, well-worn machinery presented the possibility of an overheated bearing or friction heat igniting dust accumulations. Loss: $260,900 (buildings, $34,600; machinery, $42,500; stock, $45,300; business interruption, $138,500).

March 20, 1946, Superior, Wis., Furniture Factory:

Automatic but sub-standard fire doors which failed to close permitted fire to extend through two of three sections of this large factory. The plant occupied a three-story, unsprinklered, brick and mill-constructed building subdivided into three sections by fire walls. Contributing factors to the loss included failure of watchman service (first notification came from neighbors three blocks away) and relatively weak water supplies in the area (a suburb location). The alarm was received by telephone at 9:22 P.M. and four engine companies and three special service units responded. Preplanning and knowledge of the plant through repeated fire inspec-



Failure of substandard fire doors to close allowed flames to sweep past a fire division wall and destroy two of three sections of a furniture factory in Superior, Wis., on March 20.

tions permitted fire fighters to use hose streams effectively at a second fire wall and thus save the third section of the plant. This stop was made despite the fact that protection at openings in this second wall were sub-standard. When the two cisterns available (total capacity 140,000 gallons) were exhausted, a 1000 g.p.m. pumper took suction from the water-filled basement. Additional water was secured from larger city mains through hose lines which stretched more than 1700 ft. Loss estimated at $125,000.

March 21, 1946, Pittsburgh, Pa., General Storage Warehouses:

One of the largest fires in Pittsburgh's history did heavy damage to a group of unsprinklered, interconnected railroad warehouses and consumed huge quantities of scarce foods, including tons of butter and sugar and large quantities of olive oil. Investigation of the loss is still underway, and arson is suspected, inasmuch as indications are that the fire broke out simultaneously in three or four places about 11:00 P.M. An open stairway leading from a wholesale egg store to the second-story food warehouse section seems to have been the center of the flames when fire fighters reached the scene. A train shed, running for five or six blocks at the third floor level, was heavily damaged, as were loaded freight cars. The fire was discovered by a passer-by despite the fact that watchman service was available. Forty companies worked on the blaze for hours under the direction of Chief Davis of the Bureau of Fire. Loss estimated as high as $2,000,000, with food losses alone set at $700,000.

March 27, 1946, Tarlac, Philippine Islands, Conflagration:

Their houses were almost wholly made of bamboo, palm leaves, and cogon grass with a few of timber with galvanized iron roofs. Their town had been razed in January, 1945, during fighting between Japanese and American troops. Their protection was limited to a police force of forty plus sixty members of the military police command. Their fire defense equipment was limited to a few axes and shovels, their water supply to a few hand pumps taking suction from meager wells, their alarm system to three pistol shots in the air. Against this background of insufficiency, a fire (believed caused

International News.

Tons of scarce food, valued at $700,000, were lost in this $2,000,000 fire in Pittsburgh on March 21. Investigation of the cause is still under way. Lack of automatic protection permitted the flames to sweep the railroad warehouses for several city blocks.

International News.

Weak water supplies for fire department hose streams, light construction, and failure to cut off special hazards with fire-resistive wall construction combined to contribute to a total loss of a heavy metalworking plant in Garfield, N. J., on March 28.

by ignition of buri leaves used for roofing by a cooking fire) broke out at 2:40 P.M. in the rear of a hardware store. By 6:00 P.M. 300 homes and 40 business properties were consumed by flames, and some burned for the next 24 hours. Miraculously there is no report of loss of life, but a high wind spread the fire so swiftly that property owners could save little before the avalanche of flames. Loss estimated in U. S. money at $125,000 to $150,000.

March 27, 1946, Lancaster, Pa., Tobacco Warehouse:

An estimated 2,750,000 pounds of cigar "filler" and "wrapper" tobacco was destroyed in a 2:03 A.M. fire which gutted a 3½-story and basement, unsprinklered, brick-joisted, tobacco warehouse with a ground floor area of 8000 sq. ft. Set by a medically discharged army veteran "just for a thrill," the loss was linked with the $142,600 fire in the same class of property on January 18, 1946 (see April, 1946, NEWS LETTER) in the same city. A sentence of from five to ten years in the penitentiary has been invoked on the 24-year-old arsonist. The spread of the fire, starting in the basement, was abetted by the high combustibility of the contents, lack of protection at either horizontal or vertical openings, and a seriously undermanned fire fighting force. No outside assistance was called in, although maximum utilization of available pumping capacity was impossible because of the shortage of manpower. Only 21 men responded with seven pieces of apparatus, and while the off shift (17 additional) was later called in, the fire burned beyond control. The warehouse, used for dead storage, was unheated, without watchman or fire detection devices, and electricity had been off since March 24. Loss: building, $100,000; contents, $750,000; exposure, $92,000; total: $942,000.

March 28, 1946, Garwood, N. J., Metalworker:

A 470 ft. by 250 ft. metalworking plant and foundry was destroyed by a 9:45 P.M. fire which originated in a plate shop where welding and paint spraying operations were conducted in the same area. Although the exact cause has not been determined, it is considered possible that vapors in the spray booth were ignited by a welding spark or that unshielded frame walls and partitions were ignited by the same source. Two employees in the building and a passing police officer sent in the alarm simultaneously to the small volunteer fire department by both telephone and box alarm. Fire equipment and personnel from two other communities aided in fire fighting work, and a total of eight hose streams were used. The fire spread quickly throughout the frame, one-story area and spread to adjoining brick portions via unprotected openings. Metallic dust, gasoline-thinned paints,

International News.

The rubber tire stock of the Marine Corps was greatly depleted when fire completely destroyed two frame, unsprinklered warehouses in South San Francisco on March 28.

light frame construction, and poor housekeeping contributed to the spread of fire. Partial sprinkler protection in the woodworking shop was ineffective in halting the blaze, which originated in the unprotected area. A small gravity tank supplying these sprinklers was seen to fall from the roof during the early stages of the fire. The weak public protection and the inadequacy of hydrants in the area also contributed to the loss. Loss estimated at $500,000 (fire damage $392,000 and $108,000 use and occupancy).

March 28, 1946, South San Francisco, Calif., Warehouse—Military:

Lack of automatic sprinkler or alarm protection plus weak water supplies were two of the chief elements preventing control of a fire which raged through two one-story frame warehouses, 200 ft. by 150 ft. in size, and spread to a third, 50 ft. by 150 ft. Located on the property of the U. S. Marine Corps supply depot, 12,500 tires, 50,000 tubes and other equipment were destroyed. The fire was first discovered by Marine guards at 2:35 A.M., but the alarm to the city was delayed, since the Service Department did not call for assistance and notification was not given until a watchman telephoned from a gate a half mile away. Water had to be drafted from the bay since the supply to the 12-in. main was run through a single 6-in. meter, another meter of similar size having been disconnected for economy. The warehouses lacked any fire cutoffs and the spread was so rapid as to make impossible effective extinguishment after the second warehouse became fully involved. Loss: $770,000 (96% contents).

March 29, 1946, Hull, Quebec, Group Fire:

A carelessly discarded cigarette butt has been blamed for this costly fire, which first destroyed part of a railroad and vehicular bridge over the Ottawa River and then spread to 16,000 cords of pulpwood and a large conveyor in the yards of a large paper mill. Breaking out at 6:43 P.M., the fire was first reported through a fire alarm box. Fire fighters from Hull arrived at the scene to find the creosoted wooden deck of the 45-year-old bridge was burning fiercely and that embers (in the strong wind) had already ignited stocks of pulpwood which was stacked within fifty feet of the approach to the bridge on the Quebec side. Ottawa fire fighters were able to check the flames in the first of the main spans, but not before the track and bridge members had been heavily damaged. Extinguishment of the pulpwood fire was exceedingly difficult because of lack of segregation of piles, dried out by recent warm weather, high winds, and spread by oil soaked ground and a wood tunnel under the huge stock pile. Twenty-one hose streams were required, and final extinguishment was not accomplished for 49 hours. Coming on

the heels of another large pulpwood loss in Quebec (see January QUARTERLY, pages 232, 234), it is obvious that the difficulty in fighting such a fire is directly in proportion to the size of the pile, and the best fire protection measure is to split the storage into several small piles, suitably spaced from each other, so that extinguishment with ample water supplies and monitor nozzles can be accomplished without disastrous losses: Loss: Pulpwood, $425,000; conveyor and mill buildings, $150,000; bridge, $350,000; total: $925,000.

April 5, 1946, Winnipeg, Manitoba, Grain Elevator:

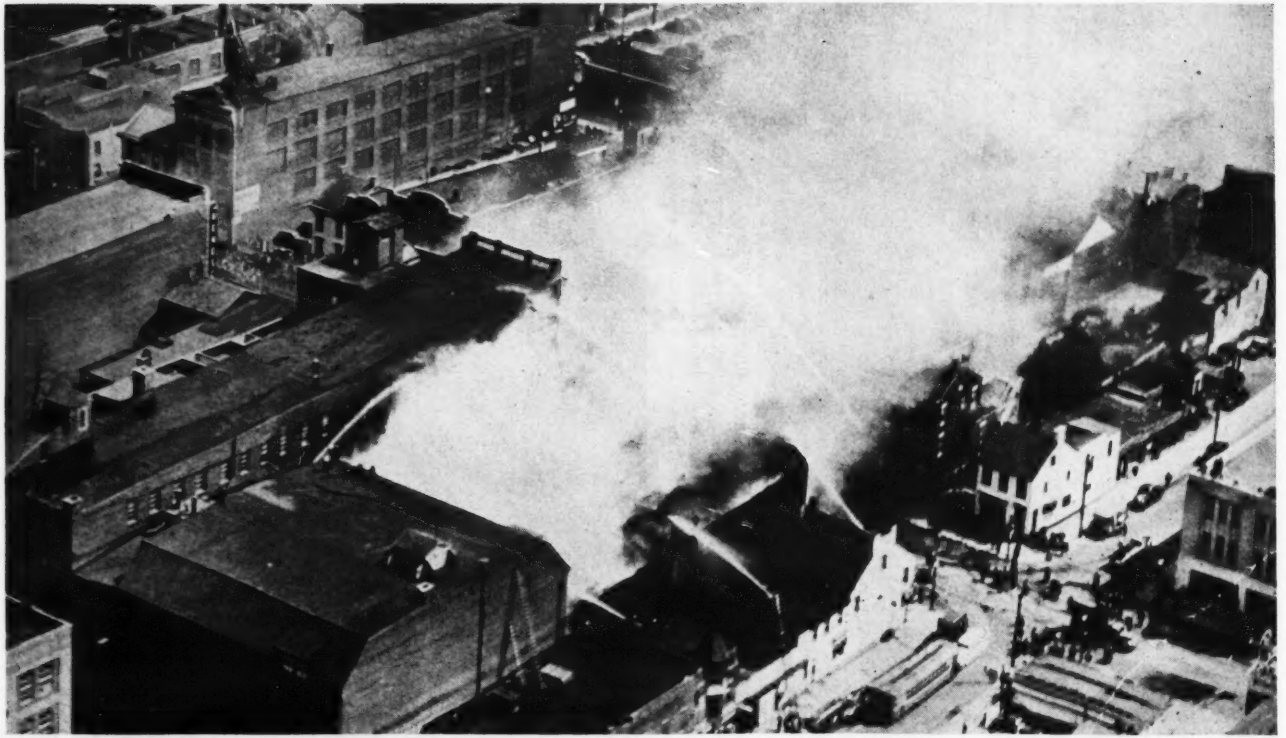
Stocks of quality seeds of alfalfa, peas, sweet clover, and brome grass will not reach war devastated areas as originally scheduled by UNRRA because fire swept a new, three-story storage elevator being used as a collection point for overseas shipment. When fire fighters responded to the 9:12 P.M. box alarm, pulled by a passer-by, the flames, which seemed to have started in a railroad box car, had already heavily involved the brick and frame structure. Dust explosions accelerated the spread of fire, and flames leaped more than 100 feet in the air. Eighteen hose streams were used, but the effectiveness of even this amount of water was negligible. The cause of the fire was not determined at last report. Loss: $150,000 (building); $250,000 (contents).

April 10, 1946, Allentown, Pa., Multiple Occupancy, Mercantile and Apartments:

Smoke was first detected at midnight, but no fire could be seen and nothing was done to report the incident. At 4:30 A.M. and at 7:00 A.M. smoke was again detected by separate parties who did not call the fire department. Finally, at 9:00 A.M., passers-by noticed smoke and pulled an alarm box on the street. When firemen reached the scene dense smoke was billowing from the building and the seat of the fire was inaccessible because the delay had permitted flames to block access to the basement. Ventilation ducts acted as channels to spread the fire to the roof, and most of the fire suppression work had to be conducted from upper story windows and roofs of exposed properties and from the street. One fireman in the building lost his life when the flooring collapsed and he plunged to the basement. A bowling alley, fur store, lunch room, toy shop, electrical appliance store, theatre foyer, several offices and third floor apartments were heavily damaged before extinguishment could be accomplished. Some loss to exposed properties resulted because open

Acme.

Sixteen thousand cords of pulpwood in a single pile were destroyed by a fire which originated from a carelessly discarded cigarette on a nearby railroad and vehicular bridge connecting Hull, Que., with Ottawa, Ont. Discovered at 6:43 p.m., March 29, the fire was fought for 49 hours before final extinguishment.



Press Association.

One fireman lost his life as fire swept this multiple occupancy building in Allentown, Pa., on April 10. Occupants smelled smoke nine hours before the fire was reported, but did not telephone an alarm because they could not determine the source.

sprinklers on the outside of a four-story, sprinklered building were not manually operated and heat radiation caused six interior automatic sprinklers to open and operate for a considerable period. Loss: $500,000.

April 10, 1946, Butte, Montana, School:

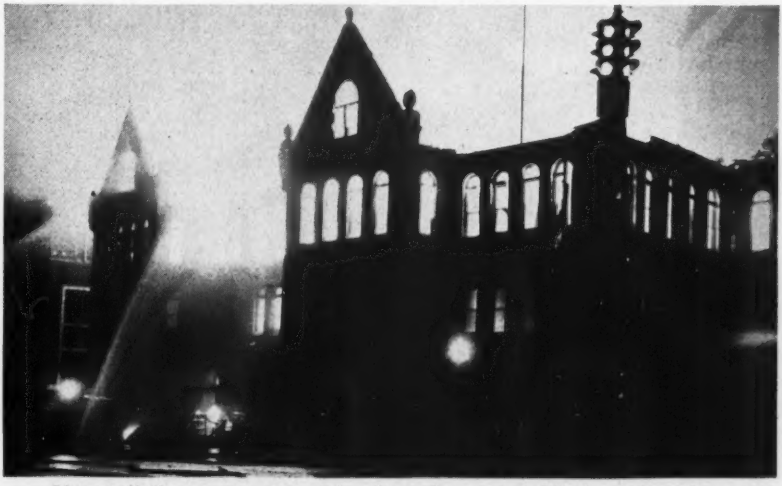
A three-story and basement public school was heavily damaged by a 9:35 P.M. fire of undetermined cause. Only the stone and brick walls remained after the wood-joisted interior and wood roof were consumed by flames. Originating in the basement of the gymnasium, fire spread unchecked throughout the 24,000-sq.-ft. structure via the ventilating system, open stairwells, and unprotected horizontal openings. The original building was erected in 1896 and the gymnasium was added in 1915. None of the structure was protected by automatic means. A Masonic Temple, seriously exposed across a narrow alley, was also damaged by the fire, but probably would have suffered even greater losses had not off-duty firemen from the city and volunteers from eight nearby communities aided in the extinguishment work. A total of eighteen pieces of equipment was massed and fifteen 2½-in. hose streams placed in service, using ample water supplies from 16-in. mains. Loss estimated at $400,000 for the building and contents, plus $25,000 for exposed property.

April 11, 1946, Montreal, Quebec, Furniture Factory:

Periodic testing of sprinkler systems was shown to be imperative in the analysis of this fire, which caused heavy damage to a two-story and basement, brick and plank-on-timber furniture factory. First indication of fire was noted by employees at 3:36 P.M., when flames were noticed around the air exhaust pipes of a spray painting room of slightly sub-standard design. The exact cause could not be traced. The fire went beyond control quickly despite efforts of employees, who used hand foam extinguishers. The functioning of the dry pipe valve was registered by the operation of the alarm gong, but no apparent reduction in the extent of the fire was noted. Fire fighters, responding on a central station alarm, used six hose streams from hydrants and pumpers, and brought the fire under control within forty-five minutes. Investigation into the unsatisfactory operation of the automatic protection disclosed that a street valve on a six-inch main (where it connected with a twelve-inch pipe) was closed, preventing water from reaching the 113 fused sprinkler heads. Loss: $75,000.

April 12, 1946, Near South Williamsport, Pa., Gasoline Truck:

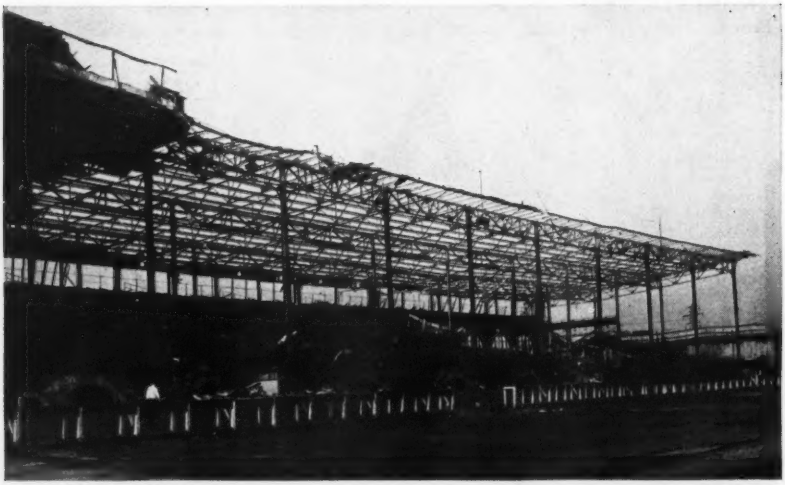
High pressure water fog was used most successfully to extinguish a blazing gasoline trailer tank truck five miles outside this city. Attacking the vehicle fire from the front, fog streams knocked out the flames in the cab within two minutes and then a semi-fog stream, directed into the burning tank through the filler cover



The ventilating system, open stairwells, and unprotected horizontal openings permitted fire, originating in the basement, to totally gut this old high school in Butte, Montana, on April 10.

One fireman lost his life as fire swept this multiple occupancy building in Allentown, Pa., on April 10. Occupants smelled smoke nine hours before the fire was reported, but did not telephone an alarm because they could not determine the source.

Three hundred and fifty gallons of water fog tamed this 4100-gallon gasoline tank truck fire five miles outside So. Williamsport, Pa., on April 12.



Toronto Evening Telegraph.

A fire-fated grandstand was destroyed for the fourth time on April 14 in Toronto, Ont. Starting in the lounge of a temporary Army occupancy under one wing of the stand, the fire flashed quickly to the wood roof.

Press Association.

A fire boat put the finishing touches on a fire in the "U.S.S. Solar" after a munitions explosion wrecked the ship, killed seven and injured more than 100 on April 30.

(which had blown off), extinguished the bulk of the remaining fire. Total water supply used to this point was 150 gallons. Overhaul operations took an additional 200 gallons, largely for cooling hot metals (especially the differentials) and the rubber tires. The truck was carrying 4100 gallons of gasoline when the fire occurred. Loss: $10,000.

April 14, 1946, Toronto, Ontario, Grandstand:

History repeated itself when flames destroyed two thirds of the 726-foot grandstand at the Canadian National Exhibition grounds in this city. The first fire to destroy the property occurred in 1906, when the original grandstand was constructed entirely of wood. This was replaced by a wood and iron stand, which was subsequently wrecked by another fire in 1912. In 1919, a third fire caused heavy damages to the same property, which was ultimately remodeled only to be similarly hit by this fire, first discovered at 1:41 A.M. Origin of the latest fire was in a lounge under one wing of the brick and concrete section used by Army personnel. The flames shot to the wood felt and gravel roof after getting a good start among the combustible contents of the lounge and an adjoining mess hall. Unprotected steel girders were warped by the heat, and some doubt exists whether the steel will be serviceable in the reconstruction. Loss: $240,000 (excluding business interruption).

April 20, 1946, Philadelphia, Pa., Chemical Plant:

Originating in an unsprinklered, three-story, slag and concrete building, 37,500 square feet in area, housing the benzol manufacturing processes, fire swept a large chemical and dye plant. Acrid smoke billowed 1000 feet above the city and ten explosions sent flames fifty feet in the air. Fire fighters massed 75 pieces of apparatus to fight the flames for twelve hours before control could be accomplished. Complete extinguishment was not effected for twenty-four hours. Two exposed sprinklered buildings were destroyed as volatiles exploded. A light wind saved many other nearby properties, although forty families were evacuated from their homes because of the danger of ignition and explosions. The heat radiation was severe, but firemen were able to avoid spread within the plant by hose streams. Investigation is continuing, with loss indicated at $1,725,000, property damage being $1,125,000 (5% of plant value) and use and occupancy loss estimated at $600,000.

April 20, 1946, Earle, N. J., *U.S.S. Solar:*

As the result of a munitions explosion aboard this naval destroyer escort, the entire forward half of the ship caught fire. Fire fighters at-

Minneapolis Star-Journal.

Insufficient water supplies for sprinklers and hose lines prevented controlling this fire which completely engulfed the plant of an excelsior manufacturer on May 1.

tacked the flames from three tugs and three fireboats, as well as from the pier, which was equipped with hydrants at 200-ft. intervals on two 10-inch mains. One of the mains had been damaged by the explosion, but no time was lost in draughting water from the sea. Two 500-g.p.m. pumpers and two trailer units pumped water on the burning wreckage through eight 200-ft. lengths of 2½-in. hose equipped with deluge nozzles. The sprinkler system beneath the pier did not operate, as the fire was successfully confined to the vessel. Seven men lost their lives in the explosion and 100 were injured. Loss: Not reported.

May 1, 1946, Minneapolis, Minn., Excelsior Manufacturing Plant:

Sparks from a coal-fired switch engine set fire to straw on the ground in the yard of an excelsior, tow, and sweeping compound plant of frame and skeleton-ironclad construction. The engine crew thought they had the fire extinguished, but flames entered an unsprinklered baled straw warehouse of 3000-sq.-ft. area and ignited the highly combustible contents. The fire department was called promptly (2:52 P.M.) and reached the scene without delay. A 24-mile-per-hour wind fanned the flames rapidly, however, and an adjacent, sprinklered, frame

International News.

The reporting fire chief tersely listed the cause of this fire on May 2 as "pay day," referring to the fact that the watchman employed used his pay to get drunk, subsequently fell asleep in one of the stalls and neglected to turn off an electric heater. The fire destroyed twenty-two valuable race horses at the Arlington Park Race Track.

Memphis Press-Scimitar.

Prompt reporting of this fire in the dry kilns of a Memphis lumber mill on May 7 saved exposed properties and prevented ignition of priceless quantities of lumber.

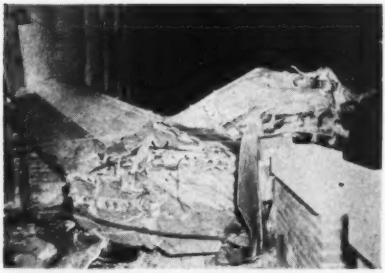
building, 225 ft. long and 110 ft. wide was involved when fire equipment reached the scene. Insufficient water supplies were quickly noted as 100 open sprinkler heads plus hose streams depleted the 6-, 8- and 12-inch mains, two of which were dead ends at the plant property line. A deck pipe had to be taken out of service, only one line could be taken from each pumper, water had to be relayed several blocks, and the situation was further complicated when employees knocked off sprinkler heads, thinking this would assist in protecting the property. By the time the fire was extinguished eighteen buildings had been destroyed or damaged. The same plant has had three previous fires, in 1931, 1935, and 1942, none of which caused such extensive damage as in this case. Loss: $577,500.

May 2, 1946, Arlington Heights, Ill., Racetrack Stable:

Twenty-two valuable race horses perished in a stable fire at the famous Arlington Park Race Track when a negro watchman fell asleep after a drinking bout and left an electric heater on in one of the stalls used for sleeping quarters. The first person to discover the fire was another watchman about an eighth of a mile away, when he observed flames coming through the roof. The local fire chief believes the fire had been in progress for about an hour before this discovery. Flames drove rescuers from the stable when they attempted to lead some of the terrified animals from the stable, and only seven were saved. The owners are currently installing a central station fire alarm system to guard against repetition of such a loss, according to local authorities. Loss: $5,000 (building); $500,000 (horses).

May 7, 1946, Memphis, Tenn., Lumber Dry Kiln:

In the words of the owners, "the Memphis Fire Department did a wonderful job in preventing the fire from spreading to our mill and office." Employees first detected flames inside one of six dry kilns at 9:26 P.M. They telephoned the alarm immediately, but by the time equipment had reached the scene, all six kilns were involved. However, this prompt reporting saved exposed properties and prevented ignition of quantities of lumber. Hose streams successfully confined the blaze to this portion of the mill property, as good water supplies were immediately available and the fire could be attacked from all sides. The apparent cause of the fire was friction or mechanical sparks on a ventilating system drive shaft located under the wood flooring of the kilns and used to operate nine fans. It is considered probable that wood scraps fell near the fans and were ignited by sparks. Loss is estimated at $200,000.



Official Photo U.S.A.A.F.

New York's second "skyscraper crash" occurred on May 20, when an Army C-45 hit the 58th floor of the Bank of Manhattan Building. Only small fires resulted from the impact as the supply of gasoline was limited to approximately 50 gallons.

May 8, 1946, East St. Louis, Ill., Poultry Feed Warehouse:

Fire, presumed to have been caused by spontaneous ignition of feed in sacks, broke out on the third floor of an unsprinklered, five-story, heavy timber, poultry feed warehouse at 8:22 P.M. An automatic fire alarm system operated and the signal transmitted to a central station and thence to the fire department. At approximately the same time a telephone call was received, when the plant engineer noticed a "light" in the building from his home adjacent to the plant. Other unsprinklered buildings, equipped with automatic fire alarms and of similar construction adjoined the warehouse, with standard single fire doors at all openings. Sprinklered passageways joined these structures with still other plant buildings which had automatic sprinkler protection throughout. A general alarm was sounded at 8:28 P.M. by the assistant chief on his way to the fire, and all apparatus available responded as well as off-duty firemen. Fire-fighting operations were conducted entirely from the exterior through small windows because of the heavy smoke and intense heat. Water streams appeared to have little effect on the fire, and three hours after the start one wall collapsed. This severely damaged a water tower without injuring firemen. Collapse of a second wall allowed flames to spread to the adjoining unsprinklered structures, from which fire had been held up to that time by the fire division wall and the automatic closing fire doors at all openings. Sprinklers operated in the interconnecting passageways to prevent the spread of the raging flames to the sprinkler-protected areas. An aerial ladder, requested from St. Louis, permitted directing streams at high elevations and finally permitted entry at the fifth floor level of one of the buildings, from which point the fire was ultimately controlled after twenty-four hours of continuous fire fighting. Loss: $450,000 (exclusive of business interruption losses covered under a $275,000 insurance policy).

May 20, 1946, New York, N. Y., Plane Crash:

The fact that the Army C-45 aircraft, which crashed into the fifty-eighth floor of the Bank of Manhattan Building at 40 Wall Street in downtown New York, contained only approximately 50 gallons of gasoline was a major factor in limiting the amount of fire damage. Only three separate fires of inconsequential size resulted; one in the basement of an adjoining building, where one of the motors set fire to a severed gas main and ruptured an ammonia pipe of a refrigerating system; one on the ninth floor of the bank building, where part of the wing landed, and one on the twenty-third floor setback of the same building to which point part of the fuselage fell. These fires were controlled by city firemen, who also quickly ventilated the fifty-eighth floor, where gasoline vapors were so heavy that the battalion chief ordered his men not to switch on the lights. Chief Fischer of the Mitchel Field Fire Department gave aid to city firemen in identifying Army authorities and in assisting with fire prevention measures. While all five of the occupants of the transport plane were killed by the impact, the late hour (8:08 P.M.) prevented loss of life of occupants of the office building, as was experienced in the crash into the Empire State Building on July 28, 1945. Damage to the building is estimated at $50,000.

June 7, 1946, Hamilton, Ont., School:

By the time the fire was discovered by neighbors at 10:42 P.M. and the fire department notified, flames had swept through the entire attic area. The building was a fifty-year-old, ordinary wood-joisted, brick secondary school and was comprised of one main section with three additions forming an "E." Only the gymnasium, built in 1930, was saved; the rest of the structure was completely gutted. The rapid spread of fire was attributed to the open attic area (30 ft. high), to the wood-joisted roof framing, to the open stairwells, to the oiled, wood floors, and to the heavy roof which crashed into the two lower floors when the supports gave way. Failure to extend the fire division walls above the third floor had a marked effect on the spread of the flames, and this shortcoming was forcefully illustrated by the effective stop made possible by the properly constructed fire wall separating the gymnasium

Acme.

Five hundred men's suits are said to have been lost in a six-alarm fire in Philadelphia on April 19. One of 82 fire alarms received by the city fire department between 12:01 a.m. and 4:00 p.m., forty-one pieces of apparatus fought for hours to bring the blaze under control. Loss is estimated at $300,000.

from the rest of the school. Recommendations made by the fire department (a year previous) for sprinkler protection, especially in the attic, were not followed. The cause is still under investigation although the possibility of lightning has been advanced because of an earlier evening thunder storm. Loss: $950,000.

June 10, 1946, New Richmond, Wis., Cereal Manufacturing:

Fire, believed to have resulted from lightning striking the third floor reel room of a one-, two- and three-story frame, ironclad cereal manufacturing plant, destroyed the main office, print shop, packaging room, "gun room," stored grain, and a farm implement warehouse section before it could be extinguished. The plant was heated by butane gas and the cereal heating retorts and lead melting pot were also operated by this gas which was supplied from an 18,000-gallon (liquid) butane tank located above ground, 60 ft. distant from the plant. It is considered probable that either the shock or resultant fire ruptured the butane gas pipe line (1½ in.) to the gun room, but, at any rate, the escape of the gas created an intense fire. The gas supply could not be cut off for about 35 minutes after the flames were first discovered by the watchman at 12:20 A.M. because of the intense heat and flames. Twelve volunteer firefighters were called by the telephone operator before the sounding of a general alarm siren, which somewhat delayed arrival of the full force of trained personnel. Limited water supplies (6-inch dead-end mains) and low pressures (pumpers aggregating 800 GPM not used) handicapped fire extinguishment efforts, while a strong wind (maximum 53 mph), a heavy downpour of rain, and salvage efforts of firefighters and mill employees (total of 75 or 80 men) assisted in reducing the loss. Five tons of rice, two and a half tons of wheat, and two tons of puffed wheat were destroyed. The entire frame area (aggregating 36,240 sq. ft.) was almost totally destroyed, illustrating the importance of segre-

Acme.

Our scanty food supplies are being further depleted by fire. About 4000 live chickens, 1600 dressed fowl, plus approximately $50,000 worth of eggs were reported lost in this fire in Parsons, Kans., on June 18.

gating large areas of combustible construction into separate fire divisions and the need for standard automatic protection. Loss: $212,000.

June 11, 1946, Coudersport, Pa., Feed Mill:

A block-sized, three-story, brick, ordinary wood-joisted feed mill was totally destroyed by a fire first reported at 11:40 P.M. The plant was without sprinkler, automatic alarm, or watchman protection and the discovery was made by a neighbor who gave the alarm by telephone. When firemen reached the scene all floors were involved and shortly thereafter a dust and heat explosion blew out the back wall. Attempts to fight the flames were of little avail as there were no fire division walls and none of the vertical openings were enclosed. Another wall caved in during the height of the blaze, while other walls were pulled down by firemen to prevent collapse. Over 250 tons of feed grain, farm equipment, and other contents (including 25% of the office records) were destroyed. A safe had not been recovered at the time the report was mailed to the N.F.P.A. Loss: $150,000.

June 12, 1946, Milwaukee, Wis., Paint Pigment Plant:

A seven-story, reinforced concrete building was the scene of this fire which started at 1:30 P.M. by the rapid decomposition of chrome green paint pigment while being processed through a crusher on the fourth floor. The fire was first observed by an employee who was feeding the "cake" into the fifth floor hopper when flames were observed coming up through the crusher opening. Attempts to shut down the machine failed because of intense heat and smoke generated by the unstable material which produced its own oxygen to support combustion. It is estimated that approximately 40,000 lbs. of the pigment were totally destroyed along with other combustible materials stored near by. The fire was detected by firemen at a nearby station about a half minute before the alarm was sounded, but because of the smoke all attempts to fight the blaze from the inside were unsuccessful until almost an hour passed. Firemen used more than eighteen 2½-inch streams with 1⅛-in. nozzles from outside vantage points in attempts to knock down the fire. Two small, open stairways to the fifth floor caused heavy smoke damage to susceptible pigments, plaster, and powders while heavy water damage was also sustained by similar materials on both floors. About 200 sq. ft. of concrete ceiling was spalled by the heat. Electrical wiring and equipment were also badly water soaked. Lessons learned include the need for sprinkler protection, the desirability of segregating stored supplies from manufacturing areas, and the necessity for cutting off the crushing operations with standard fire walls. Loss estimated at $175,000.

June 15, 1946, Bible Hill, Nova Scotia, College:

A cotton mop soaked in linseed oil was used during the day to "mop over" a floor in the Science Building of the Agricultural College in this small village outside of Truro, Nova Scotia. The mop was later hung out to dry in the sun for three or four hours and then placed in a small janitor's closet at 5:00 P.M. The last persons working in the building left at 6:10 P.M. The watchman checked the building at 7:20 by punching his clock at the single station on the second floor and noticed nothing unusual. The closet was in a corner of the building on the first floor, had metal lath and plaster walls, but combustible wall board on wood-joisted ceiling. The first experienced fireman in the building (Truro Fire Department) noted that "flames were rolling around the ceiling" of this closet. A booster line (backed up with 250 gallons of water from the truck tank) was used by this fireman and the flames were knocked down. An attempt to use a hose line from a hydrant (supplied by a 40,000 gallon elevated wood tank on six- and four-inch mains) failed within two minutes because of some difficulty in the distributing system. While the tank truck was being refilled, the building became charged with smoke and gases and eventually burned to the ground. The theory that the fire started from spontaneous ignition of the linseed oil is made plausible by the fact that its drying in the sun would undoubtedly have started rapid oxidation. When placed inside, the heat would not have been so quickly dissipated, oxidation would have continued, and heat sufficient to start actual combustion would have become a strong probability. Janitor's supplies, consisting of combustible materials (including a cot, bedding, paper towels, sweeping compounds, etc.) would have presented sufficient materials for propagation of the flames and its rekindling after original blanketing. Loss: $250,000.

June 15, 1946, Parsons, Kans., Poultry and Egg Plant:

The entire upper story of an unsprinklered, three-story, ordinary wood-joisted, brick poultry and egg plant was in flames when the fire was first observed by neighbors at 7:10 P.M. (plant not operating). While the cause of the fire was undetermined, it evidently started among some used egg cases stored in a room 30 ft. x 50 ft. The building lacked fire division walls, had an

open elevator shaft and stairwell, and floor supports were 8 x 8 pine timbers. Three engine companies used five 2½-in. hose lines in combating the flames, but were forced to concentrate on protecting exposed buildings comprised of a four-room home, a cafe, and railroad shed full of lumber. Only salvage in the destroyed plant was a safe containing $6,000 and valuable papers, while contents' losses include 4000 live chickens, 1600 dressed fowl, and $50,000 worth of eggs. Loss: $200,000.

June 18, 1946, Near Willimantic, Conn., Aircraft:

Fire in flight caused an emergency landing of a Pan-American "Constellation" (bound for Eire) at a small landing field at this city. No lives were lost in the "wheel's-up" landing, a tribute to the expert piloting of Captain S. H. Miller, who had notified the Connecticut State Police by radio to have ambulances ready for any casualties. The outstanding features of the incident for fire protection engineers may be summarized as follows. First, the plane and passengers were undoubtedly saved by the fact that the fire melted the engine mounts and the entire right outboard engine fell to the ground (6000 feet). While flames lingered in the wing and had reached the right inboard engine, the plane was successfully grounded before these fires became serious. Second, the fire was caused by several small, overheated ball bearings that fell out of a bearing race into the universal joint of a drive shaft extending from the outboard engine to a cabin supercharger and caused such vibration and flailing of the shaft that it finally ruptured a high pressure (1000 psi) hydraulic fluid line. The spraying liquid was ignited, probably by the heat generated by the malfunction of the shaft or adjacent hot metals. This failure of the bearings was the fourth such incident suffered by PAA's Constellations and brought forth a condemnation by the Civil Aeronautics Administration of the assembly, which forced all operators to suspend cabin pressurization until an improved assembly was approved by CAA. (Latest advices indicate such approval will be effected by metallurgically improved shafts and better lubricated bearings by mid July, 1946). Third, the installed engine fire extinguishing system (carbon dioxide) was used but had no effect on the fire. This failure was obviously because there was no fire extinguisher outlet in the proximity of the base of the fire (rear of the drive shaft where it enters the airplane wing), as such protection is afforded only in those fire zones dictated by previous experience (principally the carburetor and accessory sections). New regulations will undoubtedly extend the protection to the shaft. Loss: Not reported.

January 17, 1946, Linden, N. J., Refinery:

(This review corrects the original report of the fire in the April, 1946, NEWS LETTER.) The decrease of reactor vessel temperatures from 900°-925° F. to a low of 750° is believed responsible for a fire which started halfway up a 235-ft., fluid catalyst cracking unit at the Bayway Refinery of the Standard Oil Company of New Jersey. Detailed information furnished by the company indicates that oil vapors (drawn off from the reactor vessel through cyclone separators) were about at the dew point and the air rate to the regenerator insufficient for complete combustion of the oil. Vaporized oil was thus discharged with the flue gas, causing an explosion at one of the electrical precipitators and the opening of explosion release hatches. A fire of short duration occurred at 2:10 P.M., followed by the continued issuance of smoke and vapors from the open hatches. This was followed by a second mild explosion in the second precipitator at 2:30 P.M., causing ignition of the vapors still issuing from the first, and shooting flames 50-60 ft. high for about twenty minutes. At 3:15 P.M. the vapors again flashed and burned for about three minutes. As a result of this fire, operating procedures have been reviewed, minimum reactor temperatures established, and explosion hatches on the precipitators redesigned so as to be self-closing. Information at hand reveals there was no exposed property endangered as first reported in the press. An ample factor of safety in the design of the structural steel cracking unit prevented collapse of the tower. Suppression efforts were impossible at the height, and the fire was allowed to burn itself out, the unit being cleared of oil as soon as possible. Loss: $350,000.

A·D·T PERFORMANCE 1945

SPRINKLER SUPERVISORY AND WATERFLOW ALARM SERVICE

Supervisory alarms, indicating impairment of sprinkler systems . . 139,303

Waterflow alarms, indicating fires or serious leaks 2,749

Insurable values of properties protected $7,149,469,000

Ratio of fire and water losses to insurable values protected . 2/100ths of 1%

Fire loss immunity in 1945 99 98/100ths %

Average fire loss immunity during the past ten years . . . 99 98/100ths %

WATCHMAN'S REPORTING AND MANUAL FIRE ALARM SERVICE

Investigations of failures of watchmen to signal Central Station on schedule 241,842

Total number of signals recorded 324,893,005

Watchmen's patrol efficiency 99 93/100ths %

Fire alarms from manual boxes . 1,645

Insurable values of properties protected $15,166,367,000

Ratio of fire losses to insurable values protected . . . . . 3/100ths of 1%

Fire loss immunity in 1945 99 97/100ths %

Average fire loss immunity during the past ten years . . . 99 97/100ths %

Another Year of Outstanding Accomplishment

These cold, hard statistics are convincing proof of the remarkable effectiveness of A. D. T. Central Station Protection Services in minimizing fire losses.

The high ratio of immunity from fire losses enjoyed by A. D. T. subscribers and their insurance underwriters is available in all of the principal municipalities throughout the United States.

Consult with A. D. T. representatives for better protection, lower protection costs and lower loss ratios.

Controlled Companies of **AMERICAN DISTRICT TELEGRAPH CO.** *155 Sixth Ave., New York 13, N. Y.*

CENTRAL STATION OFFICES IN ALL PRINCIPAL CITIES OF THE U. S.

A·D·T

Electric Protection Services

AGAINST FIRE · BURGLARY · HOLDUP

A NATION-WIDE ORGANIZATION

WHAT WE'VE LEARNED ABOUT FIRE-DAMAGE PREVENTION

is at your disposal

For many years, we have specialized in the manufacture and application of equipment designed to extinguish fires rapidly in flammable liquids and electrical apparatus . . . keeping damage by fire *or by extinguishing agent* down to a minimum.

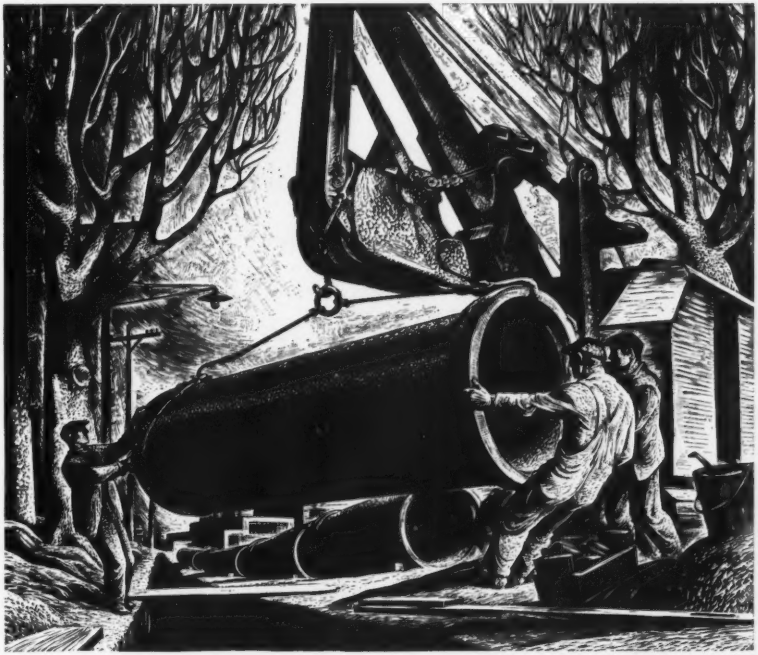
Whenever the experience we have gained in dealing with these difficult Class B and Class C fires can be of assistance to you, it is at your disposal . . . without charge, and without obligation on your part.

A Kidde representative will be glad to work with you. Feel free to call on him at any time.

Walter Kidde & Company, Inc.,
751 Main Street, Belleville 9, New Jersey

The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Kidde



Original Woodcut by Lynd Ward

FOR more than a generation this company has furnished cast iron pipe for water supply lines, distribution mains and fire protection mains to cities and towns throughout the United States, as well as for industrial plants, institutions, etc. Most of the largest high pressure fire service systems in this country are constructed of U. S. Cast Iron Bell-and-Spigot Pipe. We furnish pit cast or centrifugally cast pipe in a full range of sizes and various types of joints.

U. S. PIPE & FOUNDRY CO.

General Offices: Burlington, N. J.

Foundries and Sales Offices throughout the U. S.

What's DIFFERENT about Globe Protection

First — "A Product of the Chemical Age."

Recognizing that the most important and vital element of an Auomatic Sprinkler system is the AUTOMATIC SPRINKLER, and that larger buildings, new building materials, increasing congested areas and development of hazardous manufacturing processes have created hazards that did not exist when the solder-type sprinkler was designed, the necessity of improvement developed — to meet present day conditions— the 135, 150, 175, 212, 280 and 360 deg.

Saveall Automatic Sprinkler

Report from Underwriters' Laboratories, Inc.

RESULTS: — Bath Tests

Samples		Temp. Bath at Time Operation—Deg. F.	Samples		Temp. Bath at Time Operation—Deg. F.
135 degree	No. 1	134.5	150 degree	No. 1	150.0
	2	134.5		2	150.0
	3	134.0		3	150.5
	4	134.5		4	150.5
	5	134.0		5	151.0
	Average	134.3		Average	150.4

An ACCURACY OF PERFORMANCE and RANGE OF FUSING not obtainable with the solder type sprinkler.

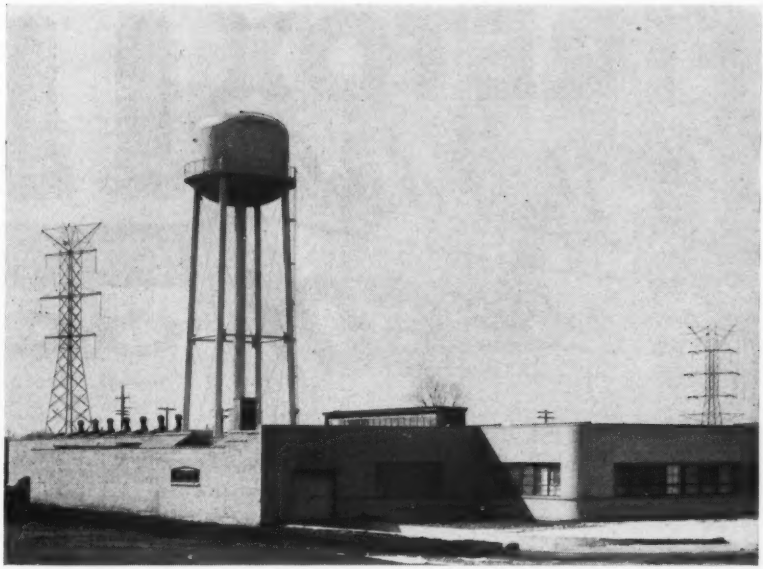
GLOBE

Automatic Sprinkler Co.

2035 WASHINGTON AVENUE

Philadelphia 46, Pa.

SALES OFFICES IN PRINCIPAL CITIES



Welded ELEVATED TANKS PROVIDE GRAVITY WATER PRESSURE

Elevated steel tanks to provide gravity water pressure for automatic sprinkler systems are available in a complete range of standard sizes — of welded construction. A typical installation is illustrated above. It has a capacity of 60,000 gals. and is 75 ft. to bottom. The cylindrical columns are fabricated from steel plates and welded directly to the tank shell.

Welded elevated tanks are smooth, streamlined structures. All surfaces are readily accessible for cleaning and painting. There are no corners or pockets to collect dirt or moisture and cause streaks or deterioration.

Write our nearest office for information on elevated tanks or flat-bottom steel tanks for fire protection service.

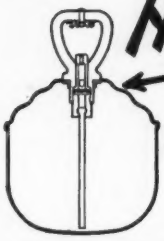
CHICAGO BRIDGE & IRON COMPANY

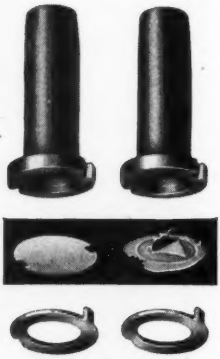
CLEVELAND	CHICAGO	BIRMINGHAM	NEW YORK
WASHINGTON	DETROIT	ATLANTA	PHILADELPHIA
HOUSTON	TULSA	LOS ANGELES	SAN FRANCISCO

Plants at Chicago, Birmingham and Greenville, Pa.

FIRETOX

The "Heart of Gold" SAYS GO!





Literally, **FIRETOX** has a "Heart of Gold." The diaphragm illustrated above is a 24 carat gold disc. Gold was selected because it would give the precision performance Firetox engineers demanded. When you buy **FIRETOX** you are buying *quality* protection against fire.

When the FIRETOX "Heart of Gold" says GO, the fire is on its way out. It releases the extinguishing medium—carbon tetrachloride—into the air at the proper moment. Immediately the carbon "tet" is transformed into a heavy vapor which settles like a blanket over a fire, smothering it quickly, efficiently. FIRETOX eliminates damage from water and obviates the danger of toxic gases. FIRETOX is your automatic watchman whose "heart of gold" controls the operation.

FIRETOX SPECIALISTS . . . are available for consultation throughout the country. Write our Main Office for "specialist" nearest you.

PATENTED

The approval identification mark of the Factory Mutual Laboratories which appears on the label of each device.

FIRETOX SYSTEM, INC.

MAIN OFFICE: 998 FARMINGTON AVE., WEST HARTFORD, CONN.

In Panic Exit Devices It's

Von Duprin

FOR HEAVY DUTY

No other fire and panic exit device compares even remotely with the genuine DROP-FORGED Von Duprin for heavy duty installations.

For the doors of schools, auditoriums, and railroad stations (as shown above), these tremendously strong devices provide the safest, fastest, surest means of exit known to man.

There are many other types of Von Duprin devices, each of which has its place, but for really rough, heavy duty service we suggest that you recommend genuine DROP-FORGED Von Duprins.

Complete details on request.

VON DUPRIN DIVISION

VONNEGUT HARDWARE CO., INDIANAPOLIS 9, IND.

A CENTRAL SPRINKLER SYSTEM

FOR EVERY FIRE PROTECTION SERVICE

SIMPLE IN CONSTRUCTION

DEPENDABLE IN OPERATION

CENTRAL Standard Wet and Dry Pipe Systems

CENTRAL Thermostatically Operated Rate-of-Rise Open and Closed Head Deluge Systems

CENTRAL Fog Nozzle Manual and Automatic Systems

Self Liquidating as to Cost Through Reductions in Insurance Premiums

CENTRAL AUTOMATIC SPRINKLER CO.

Home Office and Factory: Cannon Avenue at Fourth Street

LANSDALE, PA.

Offices and Licensees in Principal Cities of United States and Canada

SCHOOL BUDGETS
cannot pay for *LOST LIVES!*

ROOSEVELT HIGH SCHOOL, Chicago, Ill., auditorium entirely redecorated with Fiberglas fabrics. Photograph shows the stage treatment in jade green grosgrain weave. Fiberglas fabrics afford excellent acoustical properties as well as fire-safety.

FIBERGLAS* Listed by Underwriters' Laboratories, Inc., as "Non-Combustible Fabric;" approved by the Bureau of Standards and Appeals, City of New York.

No single item is more important than the sum set aside for fire protection. Yet in spite of all precautions an unavoidable accident may turn a laughing, happy throng of children into a frenzied, screaming riot during which precious lives may be lost. That is why school authorities in New York, Chicago, St. Louis and other cities are specifying Fiberglas* curtains and draperies for auditorium use. For these attractive fabrics CANNOT BURN. Woven entirely of finely spun glass filaments, *they never require flame-proofing;* always operate at 100% efficiency. Will not emit choking fumes when exposed to fire.

Fiberglas fabrics are endorsed by public safety officials in the United States and abroad for use in all places of public assembly. Installed in all ships of the U. S. Navy (Bureau of Ships Specification 27c7). Now available in a wide range of solid colors, printed patterns and interesting textures.

WRITE FOR SAMPLES AND INFORMATION

THORTEL
FIREPROOF FABRICS

ARCHITECTS BUILDING, 101 PARK AVENUE, NEW YORK 17, N. Y. • LEXINGTON 2-0711

*T. M. Reg. U. S. Pat. Off. Owens-Corning Fiberglas Corporation

"Watchmen Who Never Sleep . . ."

STAR AUTOMATIC SPRINKLERS are serving American Industry with "Round-the-Clock" protection against FIRE.

Automatic Sprinklers
Corrosion-Proof Sprinklers
Directional Flow Sprinklers
Open Sprinklers
Spray Sprinklers
Alarm Devices

Automatic Releases
Alarm Valve (Wet) Systems
Dry Pipe Valve Systems
Deluge Systems
Heat-Actuating Devices
Pre-Action Systems

Star Automatic Sprinklers and Fire Protection Devices bear approval of all Insurance Authorities having jurisdiction and various Governmental Agencies

Economy in installation cost and maintenance has dictated the consistent policy of Star Sprinkler Corporation in distributing its Fire Protection Devices through local licensed contractors who have had a lifetime of experience in the installation of automatic sprinkler systems. Operating throughout the United States, Canada and South America, Star licensees, due to their strategic locations, can render instant service. Write us for name and address of Star licensed contractor nearest your location.

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. — Philadelphia, Pa.

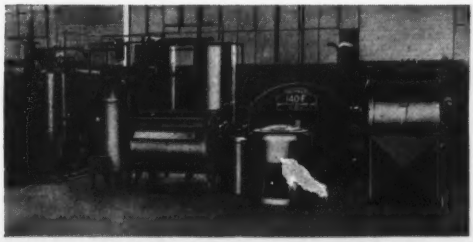
LOOK AT THE RECORD MADE BY HOFFMAN

140-F SAFETY DRY CLEANING

It's a record to be proud of—the clear loss record made by the Hoffman 140-F drycleaning system, in hundreds of installations during the past six years! The point is—this is Petroleum Solvent Equipment—not a chlorinated solvent unit! It's the original Safety Petroleum Solvent Unit—an exclusive U. S. Hoffman development to promote greater safety in the drycleaning industry. An approved Class III system, the 140-F complies with standards of National Board of Fire Underwriters Pamphlet No. 32. Most inspection departments permit installation without enclosing walls.

USES 140° FLASH PETROLEUM SOLVENT

The Hoffman 140-F drycleaning system employs safety solvent with flash-point of approximately 140° F. The system is offered to the drycleaning industry in 12 different types—each one tested and listed by the Underwriters' Laboratories Re-examination Service.



U. S. HOFFMAN MACHINERY CORPORATION
105 Fourth Ave., New York 3, N.Y.
DRY CLEANING, LAUNDRY & GARMENT PRESSING EQUIPMENT

National Foam, mechanical or chemical, puts out and keeps out petroleum, marine, chemical, aviation, industrial fires.

COMPLETE FOAM FIRE PROTECTION

NATIONAL FOAM SYSTEM, INC., specialists in Foam Fire Protection, manufactures *all* types of foam chemical and equipment. Any risk from the largest oil storage tank to a spray booth is safely guarded by National Foam.

Original developer and manufacturer of AER-O-FOAM, National produces both mechanical and chemical foam — a complete line. Applied by any of the approved methods, National Foam quickly puts out fire and keeps it out.

National Foam adheres to upright surfaces and flows freely over level areas to block off fires and gases, thus preventing flashbacks. Blanketing threatened flammable liquids, buildings and equipment, National Foam isolates fire for quick extinction.

Petroleum, Chemical and Aviation Industries are large users of National Foam. National AER-O-FOAM systems have been approved by the U. S. Coast Guard for use on merchant vessels.

NATIONAL FOAM SYSTEM, INC.

SPECIALIZING IN FOAM FIRE PROTECTION

Packard Building, Philadelphia 2, Pa.

What would Nero the Fiddler have done
If "Automatic" Sprinkler had spoiled his fun?
Rome wouldn't have blazed
and a Caesar, amazed,
Would have picked up his fiddle and run.

The familiar proverb, "Rome wasn't built in a day", could be aptly applied to the thousands of businesses that are yearly destroyed by fire, hundreds of which sustain financial ruin.

In figures, this statement is even more shocking . . . over twelve billion dollars of fire loss in 30 years. And, much of this loss could have been prevented on the basis of today's fire-fighting methods and advanced fire protection equipment. "Automatic" Sprinkler systems, for example, are now available in every field of activity and lives and property are safe-guarded as it was never thought possible to do in the past.

There's an "Automatic" Sprinkler system to suit your most rigid fire protection requirements. Why don't *you* investigate *today?* There's no obligation.

A famous member of the "Automatic" Sprinkler Family. Provides adequate protection from quench tank, transformer, oil line and other fires of flammable liquid origin.

"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 36 CITIES

"Automatic" Sprinkler manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

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It Is Your Guide to Dependable Fire Protection for Car, Truck, Boat, Plane, Home, or Factory

Wherever you see this display, you will find General Detroit's dependable approved fire extinguishers. Made by an organization with more than 40 years' experience in producing fire-fighting equipment. General Detroit extinguishers represent the ultimate in fire protection. Countless lives, as well as millions of dollars worth of property, are lost through fire every year. Your car, truck, boat, plane, house, or factory could be next. Investigate the low cost of General Fire Extinguishers. A General Detroit extinguisher at hand is a guarantee of dependable, efficient fire protection. Get yours now before it's too late.

IF IT'S GENERAL IT'S DEPENDABLE

THE GENERAL DETROIT CORP.
2270 E. JEFFERSON • DETROIT 7, MICH.
NEW YORK · CHICAGO · DALLAS
West Coast Affiliate: The General Pacific Corp.
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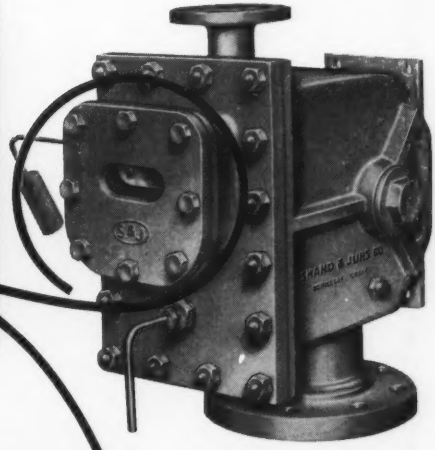
EXTRA SAFETY!

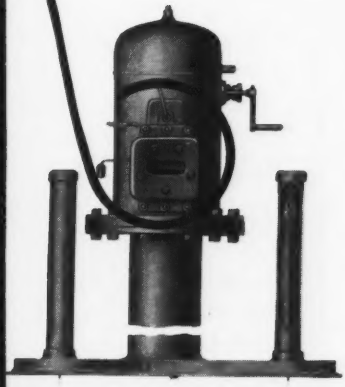
S&J



The new Safety Closure illustrated on two of the S. & J. High Pressure Automatic Tank Gauges at the right, indicates the lengths to which S. & J. engineers will go to offer complete safety to personnel, equipment and product.

In the work-a-day operation of high pressure gauges, many oil companies took the added precaution of installing a gate valve outside of the reading glass to protect the tank contents in the event of glass fracture resulting from an exposure fire.

A gate valve depends on the human element for closing and also makes it difficult to read the tape, so S. & J. engineers designed this Safety Closure. A large safety glass window is retained from the inside, utilizing tank pressure to help maintain tightness. A steel door with synthetic rubber seal, normally held closed by a small counterweight, protects the glass from the outside. The counterweight becomes the handle for opening the door when a reading is taken. It is simpler, faster, and safer than employing a gate valve.



Above, Fig. ST-400 High Pressure Automatic Tank Gauge, read from the ground, designed for pressures up to 150 lbs. Similar gauge designed for 300 lbs. Below, Fig. ST-3500, for mounting atop spheres and underground storage tanks operating up to 125 lbs. pressure.

SHAND & JURS CO.
BERKELEY, CALIFORNIA
NEW YORK · CHICAGO · HOUSTON · LOS ANGELES · SEATTLE

SHAND & JURS

RELIABLE

SUPERFINE

AUTOMATIC SPRINKLER DEVICES

Are excellent in design and construction — have a perfect field record — are universally approved by all Fire Insurance and Governmental Authorities — and effect maximum reductions in fire insurance premiums.

Comprise a complete line including Automatic Sprinklers, Open Sprinklers, Alarm Valves, Dry Pipe Valves, Circuit Closers, Water Motors and all other accessories required in Sprinkler Systems. Other fire protection devices and materials also furnished.

Reliable Sprinkler Equipment now protecting thousands of properties throughout the United States, Canada, and the world.

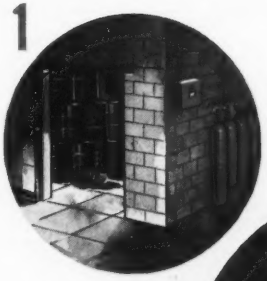
Write Us For Further Particulars
Manufactured and Distributed by

The Reliable Automatic Sprinkler Co.

Bronx and Locust Streets • Mount Vernon, N. Y.

C-O-TWO DOES IT!

1



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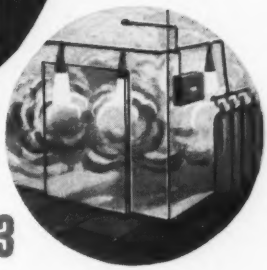

DETECTS SMOKE, ISOLATES and SMOTHERS FIRE... WITHOUT DAMAGE!

1—Here's the story of fire protection provided by the C-O-Two smoke detecting, fire isolating and extinguishing systems working together. No chance of flames spreading through open fire doors endangering men and materials in surrounding areas. The C-O-Two fire isolating system, actuated by carbon dioxide pressure, makes sure that fire doors shut!

2—The detector system sniffs in the first whiff of smoke and an alarm sounds. Instantly a pressure switch operated by carbon dioxide stops machines and ventilating fans, and pressure releases close doors, windows or other openings.

3—Then dry, inert, sub-zero carbon dioxide gas fills the space and it's only a matter of seconds from the fire's incipiency until it's out for keeps. Production schedules won't suffer because there's no clean-up, no mop-up, no damage to material, machines or finishes.

Parts of your plant may require this completely automatic fire protection. C-O-Two hose units or hand or wheeled portables are available for other hazards. Let a C-O-Two jobber or one of our fire protection engineers plan your complete fire equipment program. There's no obligation.

C-O-TWO FIRE EQUIPMENT COMPANY

NEWARK 1 • NEW JERSEY

Sales and Service in the Principal Cities of U. S. and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

like having a

FIRE DEPARTMENT

IN YOUR OWN PLANT

INDUSTRIAL SPRINKLER SYSTEMS

Viking Sprinkler Systems go into action with the speed of a Fire Department in your own plant. In peace and war Viking Sprinkler Systems are protecting industrial plants across the nation against the universal enemy of production . . . . FIRE. There is a Viking dealer near you to give you all the facts.

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C. W. Hutchinson, Inc.
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Indiana Automatic Sprinkler Co.
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Kansas City, Mo.

Viking Automatic Sprinkler Co.
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THE VIKING CORPORATION
HASTINGS, MICHIGAN

Another serious construction fire averted, because FIRE CHIEF Canvas will not flame or support combustion.

This HOOPERWOOD "Engineered Canvas" is equally resistant to water, weather and mildew, greatly lengthening its life in service.

Wherever unprotected canvas presents a fire hazard from hot coals, sparks, hot rivets, welding operations or workmen's torches, carelessly-thrown cigarettes and matches — FIRE CHIEF-Finished Hooperwood Duck assures new safety.

Approved by the Underwriters Laboratories and the Associated Factory Mutual Fire Insurance Companies, FIRE CHIEF also meets all Government requirements for a fire, water, weather and mildew resistant convas.

Specify FIRE CHIEF for protection.

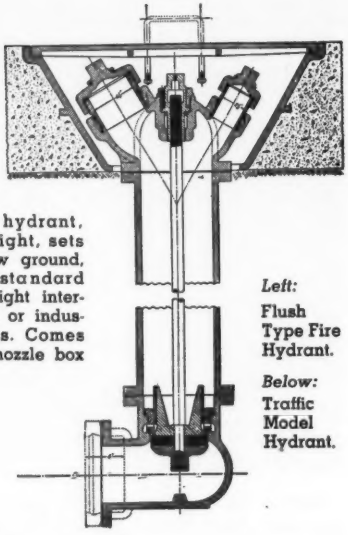
WM. E. HOOPER & SONS CO.
New York PHILADELPHIA Chicago
Mills: WOODBERRY, BALTIMORE, MD.

• Fire-Chief Finished •
HOOPERWOOD COTTON DUCK

VALVES HYDRANTS

AND PIPE LINE ACCESSORIES

M & H furnishes a complete line of AWWA Valves, iron body, bronze mounted.



Flush type fire hydrant, illustrated at right, sets completely below ground, is used where standard type hydrant might interfere with traffic or industrial operations. Comes with cast iron nozzle box and cover.

Left: Flush Type Fire Hydrant.

Below: Traffic Model Hydrant.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model is designed to yield at the ground line under impact. Repair is simple and easy.

M&H VALVE

AND FITTINGS COMPANY

ANNISTON, ALABAMA

INSTALL DUGAS EXTINGUISHERS AT THESE HAZARD SPOTS

- Paint Spray Booths
- Paint Dip Tanks
- Oil Quench Tanks
- Hazardous Liquid Storage and Handling Facilities
- Fuel Oil and Gas Installations
- Transformers and Other Electrical Equipment
- Welding Installations

STOP FIRE *FASTER*

WITH

AN ANSUL PRODUCT
duGas
THE MASTER OF FLAME

DRY CHEMICAL

DUGAS 15-T
Hand Extinguisher

● Upon striking fire, DUGAS Dry Chemical instantaneously releases 1,100 times its volume in flame-smothering gas that chokes off fire in seconds. The swift, fire-stopping power of DUGAS Dry Chemical is unaffected by wind or draft. It is undiluted by passage through the air. The gas is released only in the immediate flame area.

Dangerously close approach to flames is eliminated because the stream of dry chemical is expelled under high pressure, permitting safer and longer range fire extinguishing operation.

Amazingly fast and effective, DUGAS Extinguishers provide more fire protection . . . per pound . . . per unit . . . per dollar . . . against all types of oil, gasoline, grease, paint, and electrical equipment fires. **And DUGAS Extinguishers can be recharged on the spot.**

GET THE FACTS ON DUGAS EXTINGUISHERS

Write today for further information including authoritative, impartial data showing characteristics of all types of approved fire extinguishers. The Ansul technical staff of fire protection engineers is ready to serve you.

Listed and approved by Underwriters' Laboratories and Factory Mutual Laboratories

SEND FOR BULLETIN No. 125

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

INSURANCE WON'T STOP FIRES!

OR PUT YOU BACK IN PRODUCTION IN A FEW HOURS

Smoke pours out; the fire alarm sounds; workers rush out of the building; the fire started as a small blaze, but your plant is out of operation for weeks; all the insurance in the world won't put out the fire. But insurance is just as necessary as Pyrene Fire Extinguishers at the start. Standardize on Pyrene Protection. Control of fire in all its phases has been Pyrene's business for almost 40 years. There are specific Pyrene Fire Extinguishers for different classes of fires. A Pyrene jobber will be glad to help you determine your fire hazards and advise best methods for protection from them.

A Pyrene Soda-Acid or Water-Type extinguisher can keep a little fire from getting big — ideal for stores, office and plants or other indoor locations containing ordinary combustibles, wood, textiles, paper. Locations where oil, gas, paints, lacquers, solvents and other flammable liquids are used should be protected by Pyrene Foam, a fire-choking blanket of tiny bubbles. It flows freely over the surface of the burning liquid, covering the whole area of the blaze with an air-tight layer of foam.

CONSULT YOUR NEAREST PYRENE JOBBER OR WRITE FOR ADDITIONAL INFORMATION

Pyrene

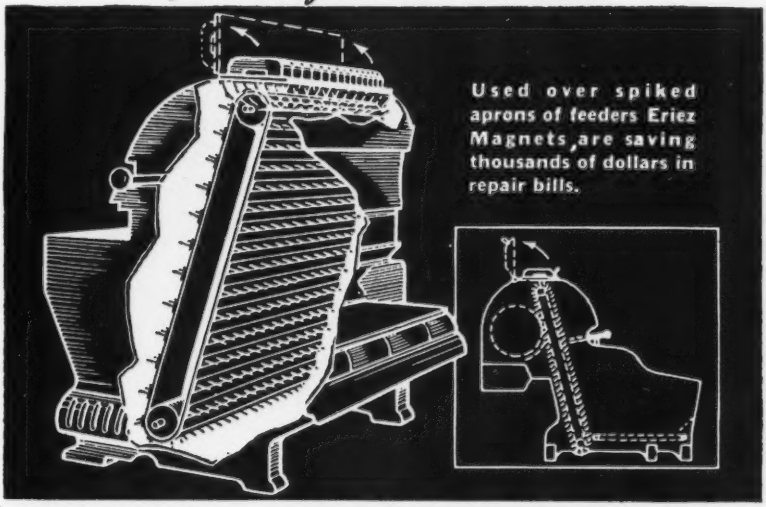
For electric equipment, diesel engines and flammable liquids, a Pyrene Vaporizing Liquid extinguisher smothers fire without injury to equipment; a non-conductor, it may be used on electrical equipment still in operation or around live wires.

Pyrene Manufacturing Company

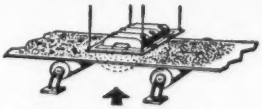
NEWARK 8 NEW JERSEY

Affiliated with the C-O-Two Fire Equipment Co.

Leading Safety Engineers and Insurance Inspectors Recommend **ERIEZ MAGNETS** *For Hazardous Locations*

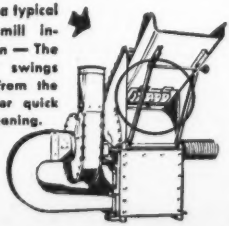


THE wide preference for ERIEZ Non-Electric Permanent Magnets in Milling, Chemicals, Plastics, Textiles and general industrial fields to remove tramp iron, cause of fires and explosions, is based on the following advantages:



Typical installation over belt conveyor

Here is a typical hammermill installation — The ERIEZ swings away from the chute for quick easy cleaning.



1. Complies with NFPA Dust Explosions Codes.
2. Entirely *Non-Electric* — cannot Spark.
3. Magnetic Field Guaranteed to Last.
4. Lowest Initial Cost.
5. No Operating Cost. No Repair Cost.
6. Lightest and Most Compact.
7. Easiest to Install.
8. Made Any Size to Fit Your Requirements.
9. MOST PROTECTION PER DOLLAR.

APPROVED BY MILL MUTUALS

Write today for Bulletin 101 (Milling), 102A (Industrial), 104 (Textiles), 105 (Magnetic Sweeper), 106 (Plastics)

When It's Magnetic Protection . . . . . See Eriez First

ERIEZ MANUFACTURING COMPANY

39 East 12th Street · Erie, Pennsylvania

Twin Fires Prove WaterFOG Faster Than Straight Stream

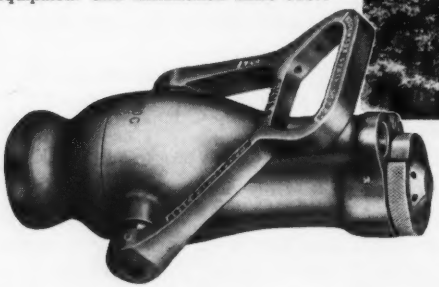
When an automobile parked between identical frame houses on Bement Avenue caught fire and the flames spread in similar fashion to both houses, the Poughkeepsie, N. Y., fire department decided to make a Class-A-fire test case of WaterFOG vs. straight stream. Fire at No. 36 was attacked with straight stream; the one at No. 38 with Rockwood WaterFOG. Here are the results:

1. Firemen at No. 38, shielded by WaterFOG, moved right into the attic and cleaned the fire up quickly.
2. Fire at No. 38 was almost knocked down before crew at No. 36 could gain entry to attic to get at the fire.
3. Overhauling negligible at No. 38, extensive at No. 36.
4. House at No. 38 suffered less from fire, water damage, overhauling and cutting. Occupants at No. 38 returned the next day; No. 36 was untenantable for several days.

For complete data on WaterFOG's ability to put out fires faster, protect men and equipment, lessen water damage, request Bulletin 123. Natural-color movies (16-mm.) are also available. ROCKWOOD SPRINKLER COMPANY, 56 Harlow Street, Worcester 5, Massachusetts. *Specialists in Fire Protection Engineering, Equipment and Installation since 1907.*

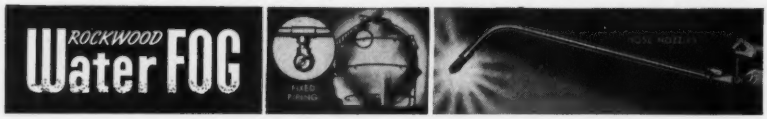
36 Bement Avenue. Straight stream was used here

38 Bement Avenue . . . and Rockwood WaterFOG here



SG-40, the triple-action fog nozzle—discharges high-velocity WaterFOG, low-velocity WaterFOG from extension applicator, or straight stream. Approved by Underwriters' Laboratories, Inc. and Factory Mutual Laboratories. Described in Bulletin G-501.

Water Engineered by Rockwood Cools, Confines, Smothers Class "A" and Oil Fires



Eliminate

Delayed Alarms

Reduce

Fire Losses

WHEN FIRE OCCURS

Call the Fire Department. Delay creates unnecessary fire waste and life hazard

Fire Alarm Boxes
Save Time and Protect Life, Property and Income

Write for details

THE GAMEWELL COMPANY

Newton Upper Falls 64 - - Massachusetts

FLAMEBUSTER

The **GRINNELL**
Improved 3-Purpose
Fire-Hose Nozzle

Grinnell offers FlameBuster, a portable fire-hose nozzle, as an effective supplement to its complete range of fixed systems of fire protection. It permits quick selection of water in the form best suited for putting out fires in both Class A materials and oils.

The Low Velocity spray, projected by a unique Grinnell tip on a 4′ to 10′ applicator, puts out fires, with minimum water consumption, in the lighter flammable oils.

The High Velocity spray extinguishes fires in heavier oils by forming with the oil a fire-extinguishing emulsion.

The Solid Stream is for mopping-up operations on wood or similar materials burning beyond the range of spray.

Descriptive folder is available without obligation. Write to Grinnell Company, Inc., Providence 1, R. I., or Branch Offices in principal cities.

GRINNELL

AUTOMATIC SPRINKLER FIRE PROTECTION